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POWER COSTS IN A SMALL TURBO-ENGINE PLANT.

One does not naturally turn to the operating records of small steam plants undergoing changes in design when seeking figures showing highly economical energy production cost, but nevertheless, the results obtained in small-capacity stations are often significant and instructive. Aside from the fact that the great majority of electric power plants scattered throughout the United States are installations of moderate capacity, it is noteworthy that in a small station the effects of changes in conditions are more immediate in their bearing upon the cost of manufacture per unit of energy delivered at the busbars than in very large plants. Thus, the addition of a fireman to the payroll of a small power house may increase the cost per kilowatt-hour a tenth of a cent, whereas in the station of many thousand kilowatts rating, such an increase in the labor account may not raise the expense per unit more than a hundredth of a cent. The moral of this is that it is dangerous to add more men to very small plants unless the total generated output has increased close to the point where the existing force cannot reasonably be expected to handle the load. Given suitable machinery, it is a revelation how many more kilowatt-hours can be turned out per man per year than with moderate-sized units of old-time design.

The far-reaching effects of comparatively small changes in conditions are plainly seen in moderate capacity turbo-engine plants which are passing out of the belted-drive stage into the more favorable conditions surrounding direct-connected apparatus. The opportunities to secure improved efficiency are plentiful in such installations, as a rule. The load, perhaps, can be handled so as to operate the turbine equipment most of the day, leaving the original engines and belted units as reserve capacity for meeting the peak requirements. The efficiency of the station in all-day operation is more important than the economy secured during the hour or two when the entire community is pulling upon the plant. Again, the steam-piping conditions, coal-handling arrangements, station illumination, switching facilities, and removal of cumbersome obstructions in different parts of the installation may be looked into with possible profit, as the turbine apparatus in a small mixed plant assumes an increasing share of the business of production.

An illustrative case is afforded by a station of about 1,000 kilowatts total capacity whose equipment three years ago consisted of four 125-horsepower, hand-fired horizontal return tubular boilers, a 400-horsepower cross-compound condensing engine, two 250-horsepower engines of similar type, and a 500-

kilowatt steam turbine. There were six generators in the plant, all but one being of the belted type. The cost of manufacture was 3.29 cents per kilowatt-hour, a high figure for a station of this capacity, but suggestive in the items composing it. The company expended $29,554 in generating 899,067 kilowatt-hours, the principal elements of cost being fuel $10,499, or 1.17 cents per unit; and wages, $14,610, or 1.62 cents per unit. Repairs and other miscellaneous plant costs were 0.5 cent. The company burned 2,396 tons of coal, costing $4.05 per ton, and 391 tons of screenings, at $2. The coal consumption per kilowatt-hour was 6.95 pounds. Of the total energy sold, 604,829 units, the power business of the company accounted for 96,012 kilowatt-hours. These results indicated that the plant was operating at poor efficiency, both the fuel and labor items being excessive in magnitude. Partial elimination of the belt-driven equipment, enlargement of the motor load, and general increase of output sold in proportion to the size of the payroll were indicated as desirable policies.

The figures of this plant for two years ago are at hand, and a general improvement is indicated. The company generated 954,470 kilowatt-hours and sold 771,038. The cost of manufacture at the station was reduced to 2.76 cents, and the total manufacturing expense was $26,427, or over $3,000 less than in the preceding year. There were savings in fuel, wages and miscellaneous items, the unit cost of coal being 1.03 cents, of labor 1.34 cents, and miscellaneous, 0.39 cent. The coal consumption per kilowatt-hour was cut to 6.3 pounds by more careful handling of the plant, and the coal purchased cost $3.78 per ton. Unfortunately, in 1908, the price of coal rose to $4.16 per ton, and the labor account increased $2,200 over 1907, although the output sold rose to 837,640 kilowatt-hours. The company generated less units than in 1907, the amount of energy delivered at the switchboard being 931,640 units. The total cost of production at the station was 3.17 cents per kilowatt-hour manufactured, the fuel account representing 1.09 cents, the labor 1.61 cents, and the miscellaneous items 0.47 cent. The company retained but two of its belted generators in this year, so that the conditions in the plant were more favorable to production, had the load not diminished. The fuel consumption per kilowatt-hour was 6.5 pounds.

The above data represent nothing in the way of plant performance that warrants praise, but they indicate how far a small change in conditions may affect such an installation. The total cost of manufacture in all three years lay between $26,400 and $29,600, and the total generated output varied only about 60,000 kilowatt-hours maximum. The engine and boiler-room attendance was the same. Yet the unit cost varied about half a cent. The constant increase of sales in the face of a reducing station output indicated admirable handling of the distribution service. The fluctuations in the labor cost suggest the importance of thoroughly investigating the requirements in that direction in mixed engine and turbine plants of small capacity. There was nothing unusual in the repair items; hence they have not been specifically mentioned here. The data show that the entire plant should have expert treatment of its whole generating process; that the obsolete methods of production should be shunned except at the peak load; and that the power load should be increased if possible. No item is insignificant in such a station.

THEFT OF CURRENT.

In the earlier days of electric lighting, ingenious persons practiced a good many deceptions upon the central stations, and although detection was hard to arrive at, and the company was put to considerable expense and anxiety in apprehending the guilty ones, the matter, when an arrest was made, generally came up in the district court, and the culprit escaped with a minor penalty, if any penalty at all were inflicted. Latterly, however, due in large measure to the prominence given the discussion of this subject before meetings of the National Electric Light Association and the state associations, the culpability of a party stealing from a public corporation has been recognized, and there has been a judicial effort made to have the punishment fit the crime.

In this direction Senate Bill 373, introduced by Senator Bardwell and which recently passed the Colorado Legislature, is of interest. This bill provides that any person who connects or changes any wire, cord, socket, or other instrument, with any wire transmitting or supplying electricity to any house, store or building without the knowledge and consent of the corporation owning the wire, in such a manner that any portion of electricity is transmitted to the device, shall be deemed guilty of misdemeanor. The bill provides also that any person who makes such changes in the circuit as to transmit current without passing through the meter provided for measuring or registering the electricity shall be deemed guilty of misdemeanor. Any person who willfully injures or alters any measuring instrument without the knowledge and consent of the corporation owning the meter shall also be deemed guilty of misdemeanor.

It is, however, in the provision as to what shall constitute *prima facie* evidence that the bill is of peculiar service. Proof of the existence of any pipe connection, or of any injury, alteration or obstruction of the meter as provided in the act, shall be taken as *prima facie* evidence of the guilt of the person in possession of the premises where such connection, injury, alteration or obstruction is brought to exist. The penalty for violation of any of the provisions of the act is a fine of not less than $50 or more than $300 or imprisonment in the county jail for not less than thirty days or more than ninety days, or by both such fine and imprisonment.

THE GREATEST HYDROELECTRIC SYSTEM IN THE SOUTH.

In five years there has been built up along the Catawba River in North and South Carolina the greatest hydroelectric system in the South.

With the Rocky Creek plant just started the Southern Power Company has a generating capacity in its three water-driven stations of 54,600 kilowatts, or 78,800 electric horse-

power. These plants are all three in South Carolina and about thirty-two miles in their greatest distance apart. Just south of the North Carolina line comes the Catawba plant, some twenty-nine miles downstream is the Great Falls station, and three miles below this latter point is the development just completed at Rocky Creek.

The Catawba plant began to operate in March, 1904, and in September, 1906, it had a peak load of 10,000 horsepower with a generator capacity of 6,600 kilowatts, or 8,800 horsepower at normal rating. Within one-and-one-half years after the starting of the Catawba plant, that is in September, 1905, work began on the development at Great Falls, and was completed in March, 1907, giving a construction period of about eighteen months for this hydroelectric station of 24,000 kilowatts generator capacity. Within a year after the development of the Great Falls site was under way, that is, in August, 1906, clearing began at Rocky Creek, and the completion of this latter plant in April of the present year gives it a construction period of about two-and-two-thirds years, but this reduces to two years since the masonry work was started.

Beginning with the Catawba plant in March, 1904, and coming to April, 1909, a space of thirty-seven months, these three hydroelectric stations, with a combined capacity of 54,600 kilowatts, have gone into commission along some thirty-two miles of the Catawba. More than this, within the past year construction has been started at what is known as the Ninety-Nine Island plant, near Blacksburg, S. C., on the Broad River, where it is proposed to install six generators of 3,000 kilowatts each, a total of 18,000 kilowatts, or 24,000 electric horsepower. The date for the completion of this fourth development is fixed early in 1910, and it will give the Southern Power Company a combined capacity of 72,600 kilowatts, or 96,800 electric horsepower in water-driven generators. Such a record of aggregate capacity at several different stations in a single system all completed in a period of six years has probably never been equaled anywhere else.

For the connection of the above generating stations with each other and with the chain of cities, villages and manufacturing plants that stretch from Rock Hill and Yorkville, S. C., on the south, to Salisbury and Statesville, N. C., on the north, nearly 300 miles of tower lines and pole lines have been built, with a much greater length of transmission circuits. The double circuits on steel towers connect the generating plants at Rocky Creek, Great Falls and Catawba, and run to Charlotte, Concord and Salisbury.

Originally these transmission circuits were operated at 44,000 volts, but provision was made for doubling this voltage to 88,000 when desired, and it is understood that this increase has been put into effect on the double trunk line that connects the generating stations and larger cities.

At the Catawba station, which was designed before the present ownership began, the current is delivered at about 11,000 volts and is transmitted to some points only a few miles distant at this figure, but the generators at this station are also connected with the 44,000-volt line through three transformers of 2,000 kilowatts each, so as to operate in parallel with the other plants.

The Great Falls and Rocky Creek plants are equipped with 2,200-volt generators and with transformers that raise this pressure to 44,000 volts for transmission.

In the distribution of energy from the various substations to the manufacturing plants and lighting stations that are supplied, a voltage of 550 is employed at some points and of 2,300 at others. The great bulk of the energy is used by cotton mills, and the voltage of distribution is largely determined by that of their motors.

During the first year or two in which the transmission system was operated the tendency of the mills was to use 550-volt motors, but more recently the practice has been more general to adopt 2,300-volt motors where the sizes made it practicable.

DEVELOPMENT OF THE CENTRAL-STATION INDUSTRY.

No more convincing assurance of the present strong standing and the excellent future prospects of the central-station industry of this country could be desired than the marked success of every detail of the convention of the National Electric Light Association that is at this writing being held in Atlantic City. The record-breaking attendance, the great variety of live subjects being discussed and the earnestness and enthusiasm of all the participants are only some of the indications of the far-reaching interest being taken in central-station developments at the present time. Despite the serious depression in all industrial activities during the past eighteen months, the central stations have grown not only in numbers but in strength. Their business in every department has increased and their activities in new directions have multiplied. While electric lighting still forms the backbone of the business, there has been an extraordinary growth of motor load, of electric heating and lately of current supply for traction systems. It was some time ago realized that in order to get the maximum return from the station and line equipment it was necessary to build up a business that would keep this equipment fully loaded as large a part of the time as possible. The diversity in the peak periods of the lighting and other branches of the business have had such a markedly good effect on the upbuilding of the load factor that there are now comparatively few central stations that maintain a lighting business exclusively. This is doubtless one of the important reasons for the inability of municipal lighting plants to pay for their investment. The acquisition of traction load and of electrochemical load, such as electric-automobile charging, have not yet received the attention they merit. That these lines are being investigated is a most hopeful sign of the times. All in all the prospects are very bright for a phenomenal expansion of the central-station business within the next few years in these directions as well as in those already largely exploited.

Chicago Electric Club.

On May 19 the Chicago Electric Club held its regular weekly meeting in the grill room of the Chicago Automobile Club, with F. P. Vose presiding. The speaker of the meeting was Dr. David Kinley, professor of economics and dean of the Graduate School of the University of Illinois.

Dr. Kinley spoke of the development of this institution, which he designated as one of the newer and more liberal universities. It now comprises the Agricultural, Engineering, Natural Science, and Arts Colleges. Following the success of the Agricultural Experiment Station, there was organized an Engineering Experiment Station. This was the first of the kind established at a university, and has been developed largely by Prof. L. P. Breckenridge.

The speaker referred to the work done at this experiment station, and the railway test car, which has traveled over a great many railway systems and been used in making dynamometer and various railway tests. An electric-railway test car has also been built, and has likewise drawn much attention to this feature of the work. Among the large number of researches that have been carried out at this experiment station are some extensive tests on the use and strength of reinforced concrete. During the past year the experiment station has been overwhelmed with requests to make tests and researches from manufacturers throughout the state.

Dr. Kinley closed his remarks by referring to the commercial and business courses, over which he has jurisdiction. He called attention to the rapidly growing financial needs of the university to provide for the steadily increasing number of students, the needs of the experiment station, and the graduate school, and for more adequate salaries for the faculty. It has been difficult to retain many of the members of the faculty at the institution on account of the many offers they have received from business houses, as well as from other institutions, at a very much better compensation.

The discussion of the subject was participated in by Secretary W. S. Taussig and W. L. Abbott. The latter is a member of the board of trustees of the University of Illinois, and emphasized Dr. Kinley's concluding remarks in regard to the finances of the institution. He submitted resolutions in which the Chicago Electric Club asks the State Legislature to provide liberally for the growing needs of the university. These resolutions were unanimously adopted.

At its regular meeting, held Wednesday noon, May 26, the Chicago Electric Club listened to a very excellent address on "The Electrification of Railway Terminals," by H. H. Evans, secretary and engineer of the committee on local transportation of the City Council of Chicago. The importance of eliminating the smoke nuisance in Chicago, a great part of which is caused by the very numerous railway locomotives, had caused the city officials to make an inspection of the New York Central electrification, with a view to carrying out similar projects in Chicago. The railroad officials when appealed to for co-operation in the matter stated that electrification was as yet too intangible in results and was scarcely feasible under the conditions existing here. The city officials, however, were not satisfied with this reply, and therefore it was determined to investigate the subject more exhaustively. A commission was chosen to make a careful study of what had been done in this line in other communities and the methods that had been employed. The report of this commission, of which the speaker was a member, was made public and abstracted in these columns last October. Mr. Evans briefly reviewed the findings of this report and summarized the advantages of railroad-terminal electrification.

This question has an important bearing on the problem of securing adequate local transportation. For every person desiring to reach the suburban districts about our large cities in a reasonable time, say, forty to sixty minutes, the surface traction lines are too slow; even in their rehabilitated condition in Chicago the congestion of street traffic prevents high speed. Therefore for this service the building of elevated railroads or subways has been imperative. Another means that can be utilized at only a trifling cost compared with the latter is by the development of the suburban service of the present steam railroads. The most feasible manner of carrying this out is by electrification, particularly on the multiple-unit system, which will result in high economy of operation and permit frequent service and the variation of the train length in proportion to the traffic.

Resulting from this will be unquestionably a great increase in the traffic capacity of the road and decided satisfaction to the public.

Mr. Evans reviewed the electrification of railroad terminals that has been carried out in this country by the Baltimore & Ohio Railroad at Baltimore, the New York Central and New Haven systems at New York city, the Long Island System and the Pennsylvania Lines, also being carried out in New York city, the West Jersey & Sea Shore, the North Shore line near San Francisco, and the Southern Pacific near Oakland, Cal. He also spoke of the electrified portions of other railroads, particularly the Sarnia Tunnel on the Grand Trunk System and the Detroit Tunnel on the Michigan Central. Abroad, electrification projects of considerable magnitude have been carried out in and near Milan, in Paris, and at Liverpool, Newcastle, and in and near London.

The manner in which the electrification of railroad terminals has been carried out was then discussed. Early electric railway projects were all on the direct-current system. In Italy and Switzerland a number of three-phase lines have been established. Lately, however, the single-phase system has received considerable exploitation. As regards the source of power, Mr. Evans referred to the electrification of the Swedish railway system, which will use both steam and water power. The Italian and Swiss lines are operated mostly from waterpower. The Bavarian system will use lignite at its power house. The equipment of the transmission lines, substations and of the working conductor were then touched upon. The various methods of protecting the third rail were described, as well as the latest practice in overhead catenary construction. In regard to the equipment of the rolling stock the various types of electric locomotives were described. The locomotive in general was declared to be particularly suitable for handling through passenger and freight trains at terminals. The multiple-unit system has been found to be best adapted to the operation of suburban trains.

In speaking in greater detail of the situation in Chicago, Mr. Evans pointed out why the agitation in favor of railway-terminal electrification had crystallized on the Illinois Central Railroad, which has its tracks along the lake front. Last fall this railroad declared its willingness to carry out the electrification project and has been co-operating with the city officials in developing plans for the undertaking. A number of co-related problems will have to be solved before the final plans can be perfected. The recent extension of the single-phase Chicago, Lake Shore & South Bend Railway to Pullman,

where it connects with the Illinois Central, has brought up the serious consideration of the question whether a single-phase system might not be suitable for the entire electrification project. The rearrangement of all the trackage seems to be imperative. In the preliminary calculations that have been made by city engineers for the electrification of the Illinois Central suburban lines this can probably be carried out for less than $4,000,000, on the assumption that the electric power be bought from the central-station company. If a separate power house were to be built the capital outlay would necessarily be considerably increased. It had been estimated that on the basis of the present traffic and with the expenditure of the amount stated there would be saved by electrification the net sum of $265,000 a year in the operation of the suburban service, after allowing for sinking funds, maintenance and taxes.

Chicago Association of Commerce to Build Club House.

The Chicago Association of Commerce has issued $1,000,000 five per cent, second mortgage, gold bonds for the purchase of a site on Washington Street, opposite the new City Hall, and the erection thereon of a club house for the association.

At a meeting held recently at the Grand Pacific Hotel pledges were made by members for $200,000 worth of the bonds, and $39,000 was personally subscribed on the spot.

A meeting of the association was held on May 26 last at the Great Northern Hotel, at which John F. Gilchrist, assistant to the president of the Commonwealth Edison Company, gave some interesting particulars of the work and growth of general usefulness of the Commonwealth system. At the close of this talk the assemblage joined in singing an original song by Angus S. Hibbard, vice-president and general manager of the Chicago Telephone Company, entitled "Our New Building."

The success of the bond issue seems practically assured. The proposed building will have twelve stories, besides a basement and sub-basement below the street level. The second and third floors and part of the ground floor will be used by the club. The sub-basement will contain accommodations for boilers, coal storage, motors, dynamos, and all the other service and mechanical equipment necessary for the operation of a modern building. The rest of the building will be rented out for offices, etc.

Lewis Institute Branch of the American Institute of Electrical Engineers.

The concluding meeting of this season of the Lewis Institute Branch of the American Institute of Electrical Engineers was held on the evening of May 26 at the Lewis Institute, Chicago. The programme began with the annual dinner, at which eighty members were present; then followed addresses by retiring officers and the election of new officers for the ensuing year. A public lecture by Frank L. Perry on "The Wright Aeroplane as a Basis for Wireless Telegraphy" closed the programme. At this lecture the attendance was about 400.

Mr. Perry first narrated his experience as representative of the WESTERN ELECTRICIAN at the government trials of the Wright aeroplane conducted last September by Orville Wright at Fort Myer, near Washington, D. C., and which were reported in these columns at length. By the aid of lantern slides and simple yet complete models of the machine built by the lecturer himself, the construction and operation of the aeroplane were described clearly and in considerable detail. Although no authoritative explanation of just how the machine flies and balances itself has ever been made public, Mr. Perry gave a clear and very logical demonstration of his conclusions in the matter. He showed that the simultaneous warping of the planes and the turning of the rudder are used to maintain equilibrium as well as to steer the craft. The method of starting the engine and getting the machine under way was also demonstrated. The importance of maintaining the high speed of almost forty miles per hour was made clear when the weight of the flying machine itself was stated as being about 900 pounds. To show the possibility of using an aeroplane as a wireless telegraph receiving and transmitting station, Mr. Perry had connected to his model a wireless equipment. He explained the method by which the antennæ could be arranged and showed the advantages of the aeroplane over the balloon for wireless work.

At the end of the lecture proper there was thrown onto a screen an excellent series of moving pictures showing a number of actual flights made by Wilbur Wright in France. These depicted a number of starts, flying near the ground, passing over a series of balloons 100 feet above ground, soaring at a height of 300 feet, and finally alighting safely on the ground at a predetermined spot. These pictures impressed one with the graceful maneuvering of the Wright machine in dips and around curves and its steady behavior throughout the flight, notwithstanding its great speed, all of which shows conclusively that the Wright brothers had substantially accomplished the conquest of the air.

Convention of the Society for the Promotion of Engineering Education.

The seventeenth annual convention of the Society for the Promotion of Engineering Education will be held at Columbia University and Pratt Institute, in New York and Brooklyn, on June 24, 25 and 26.

An unusually attractive program has been arranged, which will include the report of the Joint Committee of Engineering Societies on Engineering Education, by Dugald C. Jackson; a report of the Committee on Technical Books for Libraries, by Arthur H. Ford; a report of the Committee on Engineering Degrees, by William F. M. Goss; a report of the Committee on Entrance Requirements, by Robert Fletcher, besides contributed articles.

In addition a special session will be devoted to the discussion of engineering mathematics by the committee of fifteen appointed at the Chicago meeting of the American Association for the Advancement of Science, which has been requested to prepare a special report for the Society for the Promotion of Engineering Education for this meeting.

Electrify an Ancient Road.

In Exeter, Mo., situated on the "Frisco" line, there is an old steam railway known as the Cassville & Western Railroad, which runs to Cassville, the county seat of Barry County. It is one of the shortest steam railroads in the world, operated by a company comprised of citizens of the county seat, who were determined to provide Cassville with a railroad in order to guard against the town losing the county seat. The old steam road is eight miles long and has been operated for years with a single locomotive, a single passenger coach and a few freight cars. And now, after many years, it is to be electrified and will take front rank by reason of the adoption of modern methods. It will, in fact, be right up with the times.

The Largest Hydroelectric Plant.

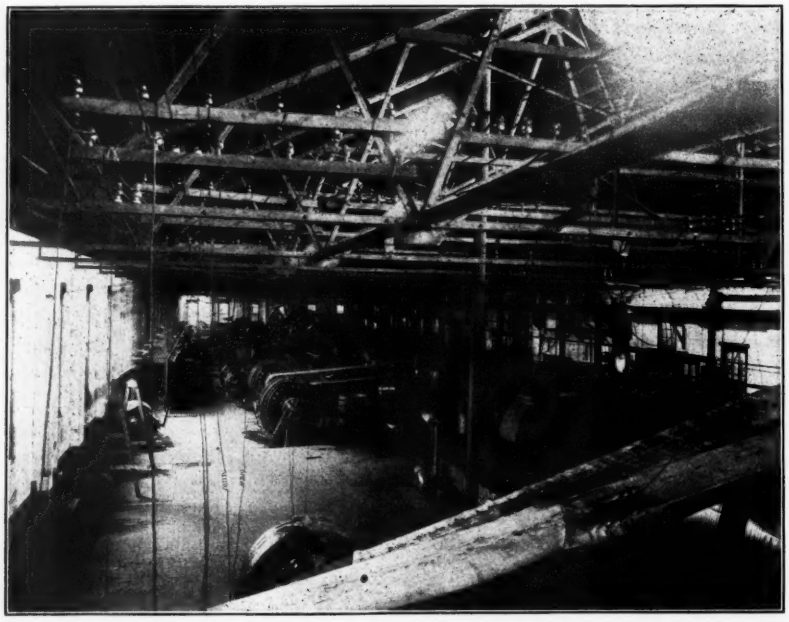
The Victoria Falls Power Company will in the near future erect what will be the largest hydroelectric power plant in the world, within fourteen miles of Johannesburg, South Africa.

Greater and Brighter Atlantic City.

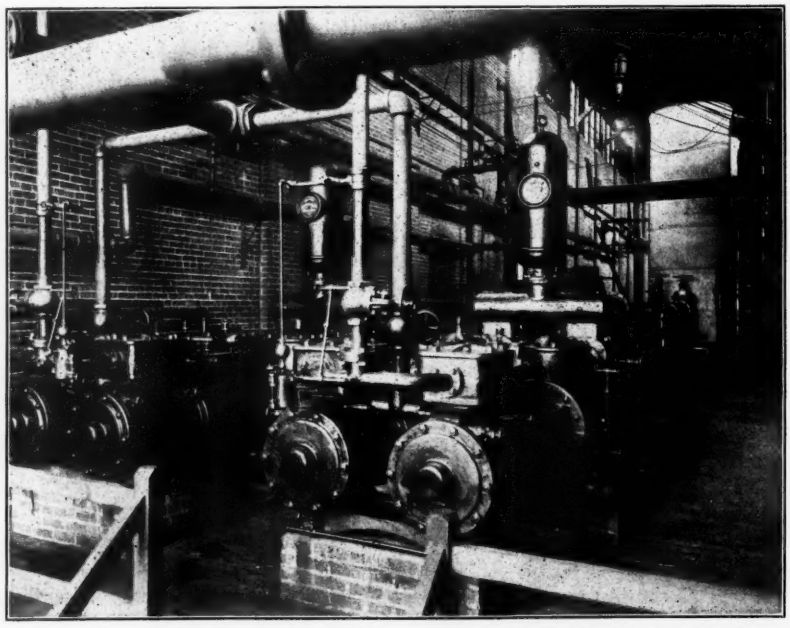
Atlantic City, with a permanent population of 40,000 and a summer population of 300,000, is a palpable contradiction of the scriptural injunction against "Building a city on the sands."

As would be expected, the most conspicuous feature is the lighting. Electricity for all purposes of light, heat and power is furnished by the Atlantic City Electric Company, which also supplies hot water for heating purposes, using the exhaust steam from the electric plant to heat the water.

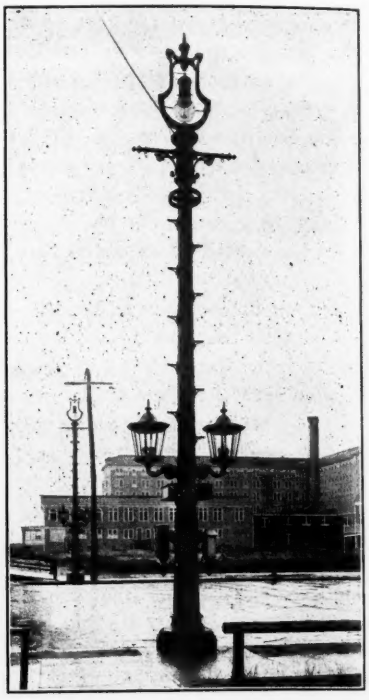
A view of the generating room of the company's station, 300 feet by 72 feet, which operates twenty-four hours per day, is shown. The equipment comprises 1,400 kilowatts in cross-compound Allis-Chalmers and Wetherill engines, direct-connected to 1,400-kilowatt Fort Wayne direct-current, three-wire machines, 110 and 220 volts; 2,400 kilowatts in simple and cross-compound engines belted to General Electric, Westinghouse and Stanley single-phase, 125-cycle alternators; seven No. 12 multicircuit Brush arc machines direct-connected to General Electric and Fort Wayne 250-volt motors.



GENERATING ROOM OF ATLANTIC CITY ELECTRIC COMPANY, ATLANTIC CITY, N. J.



HOT-WATER HEATING PLANT, ATLANTIC CITY ELECTRIC COMPANY, ATLANTIC CITY, N. J.

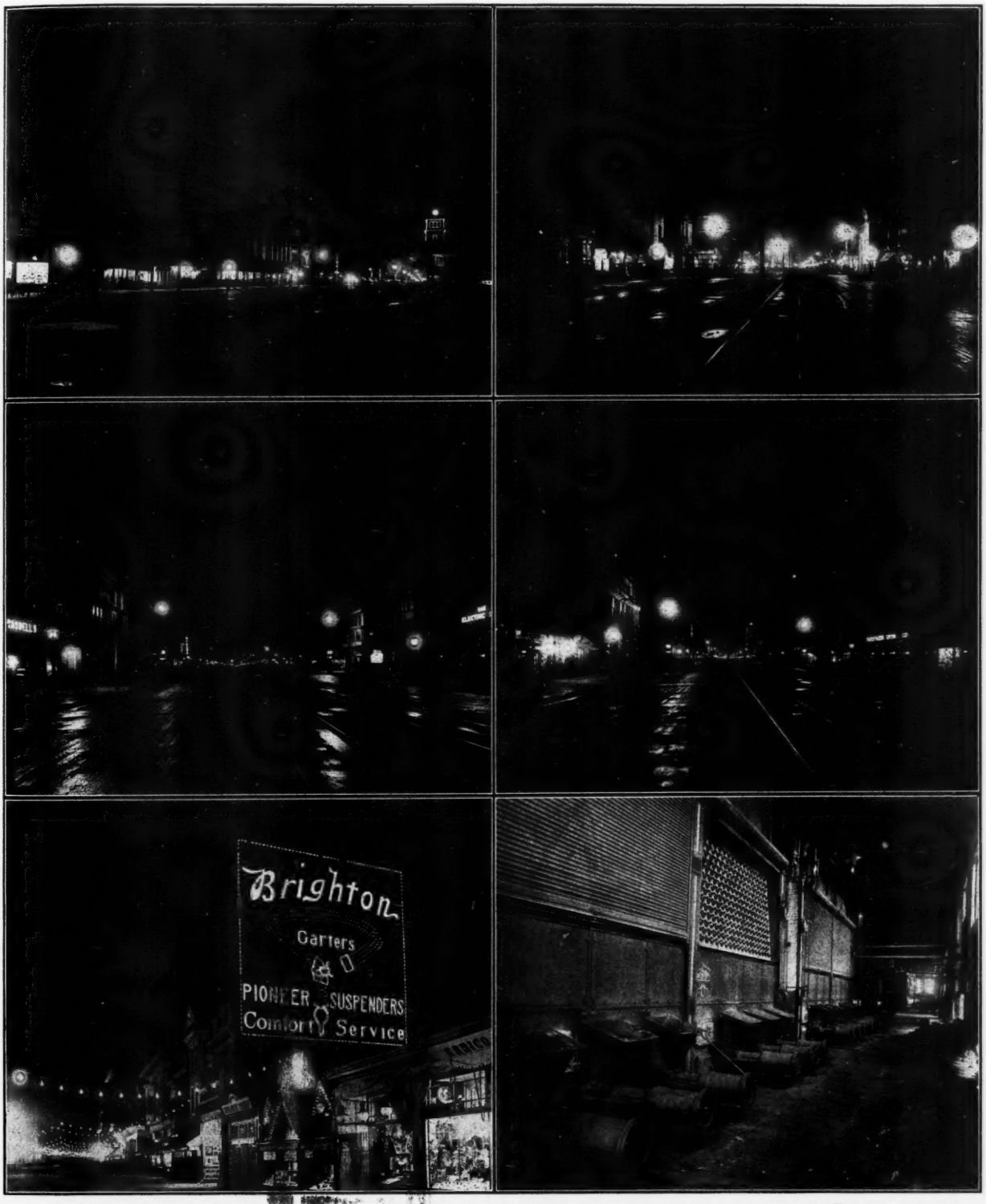


THREE MILES OF TUNGSTEN STREET LIGHTING. CORNER STANDARDS CONNECTED OVERHEAD TEMPORARILY.

Another view shows the boiler room, 275 feet by 35 feet. The equipment comprises 2,220 horsepower in Edgemoor water-tube boilers, equipped with Jones underfeed stokers; 1,200 horse-

THREE MILES OF TUNGSTEN STREET LIGHTING. INTERMEDIATE STANDARDS, 100 FEET APART ON EACH SIDE OF THE STREET, CONNECTED OVERHEAD TEMPORARILY.

power in double-deck horizontal tubular return without stoker; 1,400 horsepower in horizontal tubular return and 600 horsepower in water-tube boilers without stokers. The water for boiler purposes is pumped from a well 850 feet deep.



FOUR UPPER VIEWS SHOW EXAMPLES OF THE THREE MILES OF TUNGSTEN STREET LIGHTING. CLUSTERS OF SIX TUNGSTEN LAMPS, 100 FEET APART, ON EACH SIDE OF THE STREET. ONE OF THE NIGHT VIEWS ALONG THE OCEAN FRONT. THE BOILER ROOM.

Another view shows the hot-water heating plant, 300 feet by 20 feet. The two-pipe circulating system is used, and many business places, apartment houses and residences within a mile-and-a-quarter of the plant are heated from the street system.

A noticeable feature is the city lighting, consisting of the public buildings, fire-houses, schools, etc., and the following, exclusively for street lighting: 653 6.6-ampere enclosed arc lamps, 2,130 twenty-five-watt tungstens, 616 eight-candlepower street markers, and 9,000 four-candlepower lamps for decorative purposes.

AUTOMATIC LOAD REGULATION ON TRACTION SYSTEMS—AN EXAMPLE OF SUCCESSFUL STORAGE-BATTERY ENGINEERING.[1]

BY F. W. LAAS.

In meeting the power demands of a rapidly extending street-railway system, the type of equipment which will best meet the local conditions often arises as a serious question. Assuming it to be a commercial necessity to carry out the improvements and extensions with the same general type of machinery, the engineering question involved boils down to a consideration of the higher economies to be obtained from more improved steam apparatus, as compared with the saving in fuel and operation by means of a storage-battery installation. The proper decision on this engineering problem is not easy to arrive at, and it is the purpose of this paper to outline as an example some of the principal features of an installation of this character in which the results have more than fulfilled the expectations of the designers. As in all questions of this character, load factor is very important, affecting more than any other single factor the choice of storage batteries for the work involved. Had the all-day load factor been higher the problem would have assumed an entirely different aspect, with a possibility of additional units being ultimately adopted instead of storage batteries. But as the conditions plainly warranted a consideration of storage batteries, it is believed that the results both from an operating and a commercial standpoint will be of interest to members of this association.

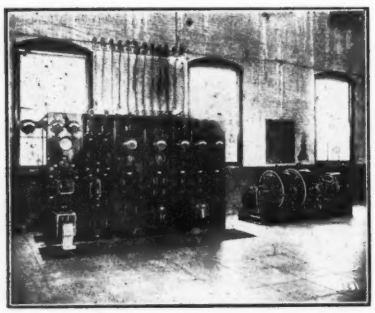


FIG. 1.—SWITCHBOARD SHOWING POSITION OF AUTOMATIC LOAD REGULATOR.

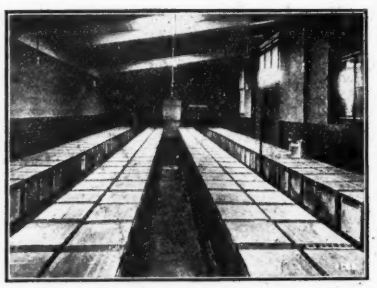


FIG. 2.—BATTERY ROOM SHOWING AUTOMATIC CELL FILLER.

In general, the results from the use of this battery installation have been positive and satisfactory. As shown by the diagrams of the load records, the degree of regulation over the very widely fluctuating ranges of load has been all that could be desired. The steam plant has been entirely relieved of light-load running and its operation under load rendered more efficient. An increase in generating capacity has been avoided, with even greater insurance against breakdowns than if extra generating capacity had been employed, and the net commercial result of the installation represents a balance considerably in favor of the storage system under the conditions of service at Cedar Rapids.

In order to appreciate fully the conditions under which this installation was made a few words of description are necessary. This plant is equipped as follows: One 18 by 36 by 42 cross-compound Allis-Corliss engine, direct-connected to a 450-kilowatt, 550-volt Bullock direct-current generator, and one 22 by 42 simple Allis-Corliss engine belted to a 300-kilowatt, 550-volt General Electric generator. Both engines are connected to surface condensers. The boiler plant consists of one 385-horsepower Erie City, and one 335-horsepower Erie City water-tube boiler (based on the usual ten square feet heating surface per horsepower rating). The steam pressure carried is 150 pounds. The fuel used is a poor grade of Iowa slack, containing twenty per cent to twenty-eight per cent ash, five to fifteen per cent moisture and a large percentage of volatile matter.

LOAD CONDITIONS.

Increasing year by year, the load had finally reached a point where the peak, due to the sudden fluctuating railway demand, greatly exceeded the capacity of the smaller unit. It then became a problem to decide on the proper apparatus to install to act as a reserve unit. The location of the power station and grounds being so situated that there could be no extension to the same, it would be necessary to install a unit of at least 800-kilowatt capacity to avoid the necessity of replacing a smaller unit after a short period of time. As the company now operates only one boiler at a time, to change the load from the 450-kilowatt unit to the 800-kilowatt unit contemplated in case of emergency peak, would certainly call for an unusual demand on the boiler. And in cleaning fires, handling cars during peak hours, and for park and certain amusement purposes, the larger unit would be equally disadvantageous to the boiler room. The fact that one unit would be standing idle the entire time would mean a larger interest charge.

There was this fact to consider also: The cars run from 5:30 a. m. to 1:15 a. m., after which time the necessary lighting was obtained from the local lighting company. If any work were to be done on the line, extra cars sent out, such as the salt car or snowplow, the plant had to operate under very unfavorable circumstances. The variable load, which would range from 100 amperes to 1,500 amperes within three seconds, brought about numerous operative difficulties, such as "looping" of the indicator cards, either in the high or low-pressure cylinders (depending on the receiver pressure and the load carried, part of the time engine not cutting off), raising the water level in the boiler, loss of vacuum, etc.

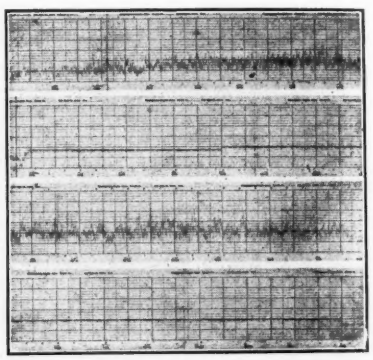


FIG. 3.—7½-HOUR CHART OF EXTERNAL AND GENERATOR LOADS.

After considering all of these factors, the decision was made to install a storage battery to absorb the excess energy on light load and return the same to the line on the heavy peaks, thus allowing the company to retain their 300-kilowatt unit, which is of ample capacity to carry the average load. For this purpose a Westinghouse battery comprising 272 cells, with a capacity of 540 ampere-hours, and a momentary discharge rate of 960 amperes was installed, together with the necessary booster and Westinghouse automatic relay load regulator to control the charge and discharge.

[1] Paper read before the Iowa Electrical and Railway Associations, April 22, 1909.

The accompanying illustrations show the general character of the installation. The most important factor is the automatic regulator shown in detail in Fig. 4.

OPERATION.

The method of operation is as follows: At 5:20 a. m. the battery is switched on the line and all cars run off the battery until 6 a. m. The generator is then run in parallel with the battery and the regulator set to carry the average load in the generator. At 12:30 a. m. the generator is cut out and the battery again operates the cars until all are in the barns; and it is then used to furnish the lighting in the barns and cars the balance of the night.

Fig. 5 shows a sample load record taken during the day with the generator running at constant load, and the external load varying according to the demands of the traction system. This covers a one-and-a-half-hour run. With the load varying from 150 to 1,100 amperes, the generator load varied momentarily less than sixty amperes maximum, the average being practically constant at 400 amperes. The second load chart, Fig. 3, covers a period of seven-and-one-half hours and shows the change in adjustment of the regulator.

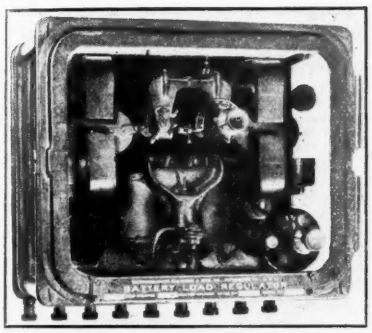


FIG. 4.—AUTOMATIC RELAY REGULATOR.

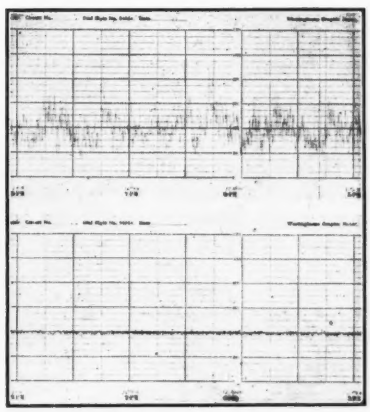


FIG. 5.—1½-HOUR CHART OF EXTERNAL AND GENERATOR LOADS.

ECONOMIES.

Several important economies result from this method of operation. First and most important, both engine and boilers may be operated at substantially a constant load, which is the condition for obtaining the very best economy. The Wheeler condenser pump may be run at a definite speed corresponding to the highest vacuum with the highest practical temperature of hot well. The boiler feed pumps may also be run at a practically constant speed. The receiver pressure may be adjusted at the proper point for a given load. Feedwater temperature remains constant at 204 to 210 degrees.

The firing of the boiler may be done under a fixed load condition best suited to economical operation. In cleaning fires under a boiler working up to its capacity there is some drop in steam pressure. This is avoided by giving the load regulator one-third turn and allowing the battery to carry the greater part of the load. If a grate becomes "stuck," the same course is followed.

There has been some saving in fuel on the plant, ranging from three to five per cent. The battery builders, however, did not claim any saving in fuel in this particular case at the present time, for the reason that the load factor remains practically the same, for while the simple engine may be operated with a high-load factor, yet the difference in economy of the compound unit even at a low-load factor slightly overbalanced the economy of the simple unit, while the booster and battery losses nearly balance the gain due to the steady load on the engine.

The fact remains, however, that while the battery was primarily installed to allow the smaller unit to act as a reserve in carrying the load, it will be but a very few years when it will serve the same purpose with the larger unit, thus prolonging the life and usefulness of the entire plant.

COMMERCIAL RESULTS.

From a commercial standpoint the results are as follows: The company was able to dispense with the services of one man at the car barns, as there are now lights in the cars all night, so the men can handle their work with less delay. This represents a saving of $600 per year. The lighting bill was formerly $200 per year. There was also a reduction in the premium on the insurance on car barn. The difference in interest charge between the cost of the storage battery and a new 800-kilowatt unit will alone pay the maintenance charge on the battery, as the builders installed this battery under a ten-year guarantee that the renewals and maintenance would not exceed a certain percentage.

In other words, summing up the foregoing, the chief value of a storage battery in a plant of this description is not so much in the fuel saved as in the reduction of fixed charges, wear and tear on machinery, the readiness to serve in an emergency, and finally the capability of the plant being operated with a maximum economy due to the fact that every phase of the situation can be studied under fixed conditions, and the necessary steps can be taken to secure the best results.

OTHER USES.

The battery has been used for several unusual purposes. The railway company has a tie line running from their switchboard to the switchboard of the local electric-light company, which operates an interurban line twenty-seven miles in length, with three substations. There is also a 550-volt, direct-current, local-power circuit operated from a 200-kilowatt, direct-current generator. It has happened that this generator has been out of commission and the substation has been called upon to supply the commercial circuit.

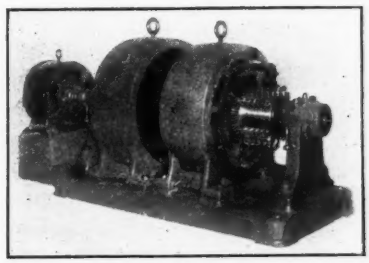


FIG. 6.—BOOSTER SET.

The drop in voltage on the line from the substation, due to the distance, was so serious that the service given was very unsatisfactory. Now, whenever necessary, the battery is connected in parallel with the substation through the tie line and maintains a constant voltage on the commercial circuit.

A Thomson integrating wattmeter is placed in the line between the two power stations, running in one direction when the railway company is taking power, and in the opposite direction when the electric company is taking power. The aim is to keep the interchange of power even by the one company or the other pulling the extreme light loads.

The 200-kilowatt generator at the electric-light station is belted to a 180-kilo-

watt, alternating-current generator, which is operated as a synchronous motor. The set was formerly brought to synchronism with one engine, but the engine has been taken out and the set is now started from the direct-current end, taking current from the railway company.

BATTERY OPERATION.

The condition of the battery is determined by the daily record of a pilot cell selected for this purpose. Fig. 8 shows a typical gravity chart from one of these pilot cells, and Fig. 7 the battery voltage record from across the battery terminal. By comparing these two charts an accurate indication of the battery efficiency and output may be had. For all normal conditions the aim is to maintain the specific gravity of the pilot cell between 1.18 and 1.19. Between full discharge and full charge the specific gravity ranges from 1.15 to 1.2. High voltage and high specific gravity indicate an overcharge of the battery, resulting in poor efficiency, and low voltage with specific gravity shows over-discharge of the battery, which, if allowed to exist for any length of time, will cause rapid deterioration. Occasionally the battery has been called upon to carry the entire load. Thus on December 15 the circuit-breakers were tripped and the battery carried the load from 3:45 to 4:15 p. m., hand adjustment of the regulator maintaining constant voltage on the busbars.

DISCUSSION.

Following Mr. Laas's paper, President Crafts, of the Iowa Street and Interurban Railway Association, called upon Louis Flanders, of the Westinghouse Machine Company, to make a few remarks on the relative cost of the battery installation and generating units, and the efficiency of this installation in relation to the output.

"In considering the application of storage batteries to such installations," said Mr. Flanders, "a great many operators and managers of railroads, and perhaps electrical engineers, have the idea that the storage battery is a very expensive luxury, and is put in usually where continuity of service is of paramount importance. That, of course, is a very important factor in railway operation, but it can be shown that besides giving improved operation, a storage-battery installation can often be made at a lower first cost than additional prime movers to secure the same results.

"In this particular case, roughly speaking, an 800-kilowatt unit will probably cost $30,000 installed on foundation, together with all auxiliary apparatus. The storage battery selected in its place costs approximately $15,000. Now here is the point where the storage battery works out to good advantage, and here is also the point, I believe, where operating men, managers and engineers get the idea that the storage battery is an expensive luxury. A storage battery put in to carry a load for eight hours would be prohibitive, because the cost of battery per kilowatt output at the above rate would be from $240 to $380, depending upon the size of the installation, while if the same battery were used to carry a peak of one hour it could carry four times the load that it could for eight hours, therefore at a cost of $60 to $95 per kilowatt, and if it were used to carry a peak of twenty minutes it could carry eight times the load that it could for eight hours at a cost of $30 to $47.50 per kilowatt. For some types of battery it could be used to carry a momentary peak of sixteen times that which could be carried for eight hours at a cost of $15 to $23.75 per kilowatt. In other words, a battery that would deliver fifty kilowatts for eight hours would deliver 200 kilowatts for one hour, or 400 kilowatts for twenty minutes, or 800 kilowatts momentarily. So that when high peaks of short duration demand additional power apparatus, the first cost of storage-battery equipment competing with steam apparatus is far less, even leaving increased efficiency out of consideration.

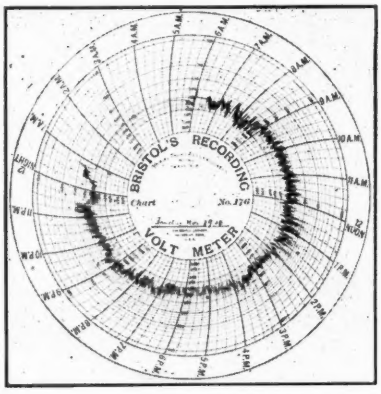


FIG. 7.—BATTERY VOLTAGE RECORD.

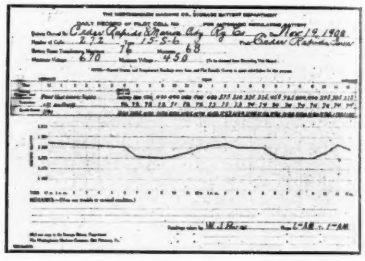


FIG. 8.—TYPICAL SPECIFIC GRAVITY RECORD.

"Generally speaking, when one is called upon to carry a peak for over an hour, additional steam apparatus is a cheaper proposition than a storage battery, unless there is some other factor in the problem, such as insurance against shutdowns and other considerations of that nature.

"Taking up the matter of operating efficiency. On the last page of Mr. Laas's paper is shown the pilot-cell record of the specific gravity of the electrolyte. A storage battery is nothing more nor less than a reservoir. When the load is light this reservoir is pumped full; when the external load is heavy this reservoir gives up its energy. The hydrometer corresponds to the float gauge on a water tank; that is, with the battery full, as in the case of the battery described in Mr. Laas's paper, the hydrometer indicates a specific gravity of 1.20; with the battery empty, a specific gravity of 1.16. The aim is to operate the battery between 1.19 and 1.18; in other words, from fifty per cent to seventy-five per cent full. This keeps the battery in condition to receive input or output of energy of short duration with the minimum loss. Therefore, since in operating this battery very little energy is taken out or put back at any one time, the interchange is accomplished with a very high efficiency, probably over ninety per cent. If the battery were discharged clear down and then recharged the efficiency would be lower—from seventy to eighty per cent. It is quite possible in operating a battery with a rapidly fluctuating load to get an efficiency of ninety-five per cent.

"Another interesting application is that to alternating-current systems, especially where the alternating current is purchased on a maximum-demand basis. The battery is connected to the system through motor-generator sets or rotary converters, and by means of a suitable regulator maintains a constant alternating-current demand from the power company; battery current is transformed to alternating current when the alternating-current demand is above the average; and conversely, when the demand is below the average, the surplus alternating-current energy is transformed into direct current and charges the battery.

"Another point not fully brought out in Mr. Laas's paper is the fact that his load factor is only about fifty per cent with the battery as now operated by the Cedar Rapids & Marion City Railway. Their average business can increase fifty per cent and their present power equip-

ment will be capable of handling it, because their average load can run up to 600 amperes instead of 400, and will still give them a margin. When that is accomplished their efficiency will be very much increased. At the present time the saving of coal is questionable, because they are operating at practically no better load factor.

"The question of depreciation is, of course, a vital factor. You must charge against your battery equipment a certain sum to take care of plate renewals, and this depends on how you are going to use them. At the present day we enter into a maintenance contract depending upon particular conditions, and we absolutely guarantee that the maintenance, when operated under proper normal conditions, will not exceed an average of a certain fixed sum per annum. That does not mean that you have got to spend each year a thousand or five hundred dollars for the maintenance of your battery. It means that in four or five years you will have to put in a new set of plates, say, at a cost of four or five thousand dollars. Now if the companies using storage batteries each year would put in a sinking fund subject to five per cent interest, $900, they would have money available when they had renewals to make, and would thus tend to cut down the guaranteed maintenance expense, provided the guaranteed amount for maintenance for ten years was $10,000.

"Depreciation is less than six per cent in some cases, although a fair average is from six to seven per cent."

Canadian Electrical Association.

The convention of the Canadian Electrical Association will be held in Quebec on Wednesday, Thursday and Friday, June 16, 17 and 18. Headquarters will be at the Chateau Frontenac.

$240,000,000 for Subways.

The New York Public Service Commission will have submitted to it bids aggregating $240,000,000 for new subways by various interests representing private capital and ready to build in Manhattan, Brooklyn and the Bronx as soon as franchises are granted.

These bids are to be made as a result of the signing of the Travis-Robinson bill by Governor Hughes. This bill makes it possible for the city to grant franchises for new subways to be built by private capital, its own capital, or with money secured by assessment of property benefited.

ARKANSAS ASSOCIATION OF PUBLIC-UTILITY OPERATORS.

SECOND ANNUAL MEETING AT HOT SPRINGS, ARK., MAY 12, 13 AND 14.

The second annual meeting of the Arkansas Association of Public Utility Operators was held at Hot Springs, Ark., on May 12, 13 and 14 last, when nearly all of the public-utility electric corporations in the state were represented, besides many of the electric supply men. President D. A. Hegarty occupied the chair. In his annual report Secretary J. E. Cowles gave some interesting particulars of a great publicity campaign recently conducted among the public-utility companies of the state relating to the legislative situation. In the annual presidential address which followed, Mr. Hegarty discussed the various measures introduced during the last legislative session and aimed against the public-utility companies. All of these, however, were defeated.

J. M. Hewitt, president of the Marianna Electric Light and Power Company, read a paper on "The Relation of Public Utilities to the Public," in which he deprecated the right of the public to control franchised corporations. The success of their business, he said, depended upon economical management, and the rates of utilities were subject to the law of supply and demand, in such a way, however, that the rates tended to go down as the demand goes up.

The second paper read was by S. F. Dibble, of the General Electric Company, on "The Sale of Motors by Central Stations." Mr. Dibble advocated the sale of motors and of all current-consuming devices by the central stations, although, if the latter considered it desirable, cooperation with local dealers might be resorted to, provided the dealers were amenable to suggestions, regulating the sales, by the lighting companies. One particular type of motor, and that of the highest grade, should be chosen by the lighting company and exclusively exploited by the dealer.

The second session was opened by J. E. Cowles, of the Little Rock Railway and Electric Company, with a paper on "Tungsten Lighting." Mr. Cowles said that his company has had much success in displacing illuminating gas with tungsten lighting, prospective customers being supplied with tungsten lamps on a thirty days' trial. The lamps, he said, should be supplied by the central station and not by the contractor, as the former can afford to dispense with a large profit on the lamps themselves, because their main profit came subsequently out of current consumed. George D. Rosenthal, in discussing the paper, said that the tungsten lamp supplied a competitive weapon with which the small lighting companies had been enabled to increase their load very materially.

W. H. Walkup, manager of the municipal plant at Searcy, followed with a paper on "The Operation and Management of Small Central Stations of 250 Kilowatts or Less." Mr. Walkup strongly objected to the flat rate and advocated meter rates for small plants. A lively discussion followed this paper in which several members severely criticized the operation of municipal plants in the state.

In the Question Box the topical subject of buying coal on specifications was well threshed out. The president suggested a concerted action by the public-utility companies to bring force to bear on coal dealers. A committee to study the situation especially with respect to draft specifications was appointed.

Fred T. Benson, of the General Electric Company, read a paper on "Tungsten Sign Lighting," which was chiefly an account of the new four-candlepower, five-watt, tungsten lamps of from ten to twelve volts. These are connected ten in series on direct-current circuits, and used in multiple on alternating-current circuits with a step-down transformer having a ratio of ten to one.

The following officers were elected for next year: President, B. C. Fowles, general manager of the Pine Bluff Corporation; first vice-president, J. M. Hewitt, president of the Marianna Electric Light and Power Company; second vice-president, S. A. Stern, of the Home Water Company, Little Rock; third vice-president, C. T. Griffith, general superintendent of the Little Rock Railway and Electric Company; treasurer, E. T. Hardin, superintendent of the Hot Springs Street Railway Company; secretary, J. E. Cowles, of the Little Rock Railway and Electric Company. The next meeting will be held at Pine Bluff, next year, at a date to be fixed later.

Advance in Wire Prices.

The American Steel and Wire Company has advanced the price on wire nails, plain wire and barbed wire $2 a ton yesterday. Plain wire is quoted now at $1.50 for 100 pounds, nails $1.70, painted wire $1.75 and galvanized barbed wire $2.

National Electric Light Association.

Opening of the Thirty-second Convention in Atlantic City.

(*Special Dispatch to the* ELECTRICAL REVIEW AND WESTERN ELECTRICIAN.)

Atlantic City, N. J., June 1.—All indications at the close of the first regular day's sessions point to the marked success of every feature of the thirty-second convention of the National Electric Light Association. The sessions, the exhibition and the entertainments have been arranged with much thought for the benefit and pleasure of the members and guests. To those early on the ground the thoroughness with which every detail had been looked after had already made a most favorable impression. The attractions of Atlantic City and the perfect weather are also elements that have helped to bring about a record attendance at the convention. Monday morning 1,500 had already registered at the headquarters. On all sides the greatest enthusiasm is being displayed in the convention's work.

Much credit is due to those in charge of the transportation arrangements for bringing the members here and particularly for the special trains from Boston and New York and from Chicago. These trains arrived practically on time and brought an enthusiastic crowd of the most prominent electrical men. The registration arrangements were as nearly perfect as could be. Members were supplied with advance copies of practically all the papers and committee reports.

The formal opening at 8 o'clock last evening (Monday, May 31) of the exhibition made by the Class D members was the first feature on the convention programme. The exhibition committee, under the direction of Frank H. Gale, chairman, and Walter Neumuller, secretary, had completed all the arrangements for making the exhibition, when the lights were thrown on, a picture perfect and beautiful in every detail. The illumination and decorative scheme were carried out by means of tungsten lamps and multi-colored low-candlepower lamps. As was to be expected from the preliminary announcement of the exhibits and exhibitors given in last week's issue of the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, the exhibition is almost exclusively composed of the latest electrical appliances and apparatus made by the most representative manufacturers.

Conspicuous among the exhibits installed in the Exhibition Hall of Young's Million Dollar Pier is that made by the National Electric Lamp Association, which has a brilliant lamp display in a rose-covered pergola. The General Electric Company is showing an extensive line of miscellaneous appliances and several entirely new productions. The Westinghouse Electric and Manufacturing Company is attracting marked attention by its numerous late devices, as is the joint exhibit made by the Pettingell-Andrews Company, the Price-McKinlock Company and the Central Electric Company, the latter making a notable display of Opalux reflectors. Among other striking exhibits are those of the Allis-Chalmers Company and the Wagner Electric Manufacturing Company; the latter has created plenty of amusement with its exhibition of the moralometer.

At about 9 p. m. attention was turned from the exhibition to the reception given by President W. C. L. Eglin, the other officers and the reception committee, to the members and guests. This was a brilliant affair and was conducted in the most graceful and pleasing manner. Following the reception, there was dancing to the accompaniment of a delightful orchestra. Supper was served in the balconies of the hall, overlooking the dashing waves of the ocean and Atlantic City's famous boardwalk. The excellent illumination, the music and dancing, the renewal of old acquaintances, all served to make this gathering of the country's noted electrical men and their elegantly gowned ladies a memorable occasion.

TUESDAY MORNING SESSION.

The first general session of the convention was opened by President Eglin in Marine Hall promptly at 10 o'clock this (Tuesday) morning. Mayor Stoy of Atlantic City welcomed the Association and its members and guests to his city. He paid a compliment to the electrical engineers and central-station men, who, he suggested, deserved recognition of their value to a city in providing it with electric service. He cited its illumination as being one of the most important elements making Atlantic City what it is today. On motion of J. B. McCall, a vote of thanks was tendered the mayor.

Mr. Eglin then delivered the presidential address. He said the Association had grown so much in numbers and importance that its work now required the undivided attention of a large corps of assistants to carry out all features of the organization's efforts. He indorsed emphatically the affiliation of state associations with the national body and considered that in many directions the much-desired standardization of practice could be carried out only by universal harmonious effort. He also indorsed the further establishment of company branches. Those already organized had proven successful beyond all expectations of their promoters. He suggested the appointment of two additional vice-presidents in order to carry out the organization work more thoroughly. The appointment of a committee to look into the question of dues of the various sections and branches was also recommended. H. L. Doherty, C. L. Edgar and W. W. Freeman were appointed as the committee on the president's address.

The report of the committee on uniform accounting was presented by H. M. Edwards, chairman. In this report was included a comparison of the Association's standard classification of expenditure and income accounts with the system adopted by the Public Service Commission of New York. The latter prepares four divisions for companies having annual revenues of different graded amounts. The report in general covered much the same ground as that presented by this committee last year.

A report of the past year's work on the Association's Question Box was submitted by Alex. J. Campbell, its editor, and was read by Secretary John F. Gilchrist. Mr. Campbell gave it as his belief that the Question Box should be made most useful to the members in comparatively small companies, as the larger companies usually have specialists in each line. There have been established a number of company branches and in some cases also company bulletins with a Question Box of their own. Among the larger companies also it has become common to designate one man to handle the Question Box for the company. It did not seem advisable to publish all of the matter in the Association bulletin that is found in these company Question Boxes. A complete revision of the matter already published in

the Question Box has been undertaken by Messrs. Campbell and Lüpke, who will be joint editors of the revised edition. The plan to be followed will be to gather the material and information found in all past issues, compile it and boil it down to such form as to make it readily available for reference. This will probably be done in the form of the loose-leaf book, each page being indexed and numbered. A permanent revision committee will be maintained to handle the material in the current issues of the Question Box. This will be added to the hand-book, and as the material becomes obsolete the pages can be withdrawn and new sheets substituted in their place.

Former President Dudley Farrand, as the Association's representative on the National Conservation Commission, presented a report of the work undertaken in this line. This was chiefly to look into the undeveloped resources in waterpowers in this country which might be utilized for the production of electricity. This work went along splendidly until Congress introduced a clause in the sundry civil bill making it impossible to devote public funds for carrying out this commission work further. However, the joint conservation committee is carrying on the work by itself, the funds being contributed by various individuals. It is generally understood that President Taft will shortly ask Congress for an appropriation to carry on the work.

The report of the committee on progress was submitted by T. Commerford Martin, chairman. In its usual comprehensive form this report covered the extremely numerous phases of central-station activity. At the beginning reference was made to the extraordinary growth of central stations, as indicated by the recent United States Census report covering the five years ended December 31, 1907. A comparison of the American conditions as shown from these data was made with foreign conditions. These comparisons showed the phenomenal strength of the central-station industry in general and particularly that in America. In contrasting American lighting methods with those in vogue in Europe, the relatively poor standard of street lighting in America was made evident. The question of regulation of rates and of franchises was gone into quite thoroughly, and the influence of a number of recent decisions by the United States Supreme Court was pointed out, particularly in the cases involving the Consolidated Gas Company of New York and the Water Company of Knoxville, Tenn. In both these decisions it was evident that the court was not overanxious to give an explicit decision on all phases of the matter. Attention was called to the decision of the New York Public Service Commission in declining to approve the petition of the Long Acre Electric Light and Power Company, of New York, to enter the central-station business there. On the other hand, in other places the decision has been in favor of competition. The work of the Wisconsin Railroad Commission, which is the public-service body of that state, was referred to, and its liberal stand commented on. A marked tendency toward the enlargement of the power of existing commissions and the establishment of public-service commissions in general was to be noted. The movement for the conservation of natural resources was touched on and its particular relation to the matter of coal supply and of control of waterpowers. A steady decline in the agitation for municipal ownership was evident as a more detailed study of the existing municipal plants shows up clearly their shortcomings. A number of the more important new central stations established during the year were briefly described and their equipment compared. Among these were the two Waterside stations of the New York Edison Company, the new Quarry Street station of the Commonwealth Edison Company of Chicago, the Redondo plant of the Pacific Light and Power Company of Los Angeles, and the hydroelectric station of the Indiana & Michigan Electric Company at Berrien Springs, Mich. Various methods of special street lighting were described. Among these were the system of tungsten arches installed at Grand Rapids, Mich., and the street illumination at Minneapolis, in which fourteen-foot ornamental standards are placed at frequent intervals along the curb line. Aurora, Ill., Newark, N. J., New York city, Los Angeles, Cal., and Rochester, N. Y., afforded other examples worth noting. The exceptionally rapid development of the tungsten lamp received considerable attention, particular mention being given to the plan of residence lighting by means of tungsten lamps, worked out by the Hartford Electric Light Company. The flaming arc lamp has made marked progress during the past year. Various methods of handling this type of illuminant were described. Among the new ideas in current-selling methods were mentioned the plans put in vogue by the Cadillac (Mich.) Water and Light Company, the Philadelphia Electric Company, the Brooklyn Edison Illuminating Company, the Commonwealth Edison Company, and the Boston Edison Illuminating Company. A marked impetus has been given to the electric-automobile business this spring. Examples of what may be done in this field were pointed out from the practice followed at Toledo, Ohio, and Rochester, N. Y. Attention was called to advances made in electrical methods of refrigeration and ventilation. In Philadelphia particularly, marked progress along this line has taken place. The electric fan has become more popular than ever, a number of companies making special campaigns to push this line of business. In the electric-heating line there has been phenomenal extension of the use of the electric flatiron. This is due not only to the aggressive exploitation of this useful device, but also to its more satisfactory service. For general cooking, a decided step in advance was made by the development of the "caloric cooker," which is an electric form of the well-known fireless-cooker idea. This promises much in the way of making electric cooking economical. In closing this general survey mention was made of the marked success attained by the Detroit company in residence lighting, the extension of electric service into suburban and rural districts, special advertising methods made use of by various companies, the protection of company meters on consumers' premises, the methods being used to decrease the electrical hazard to life and property, the relation of the central station and the electrical contractor, and finally the development of central-station welfare work.

A paper on "Private Policy," by Paul Lüpke, of Trenton, N. J., was then read by Mr. Martin. In his delightful and broad-gauged style the author called the attention of the company members to their internal affairs, since public matters have recently been threshed out quite completely. The feature of greatest importance relating to the internal organization of a company was the personnel of its employes. There are two ways of making a central station fool-proof; one is to make all its apparatus proof against fools, and the other is the elimination of the fools. Perfection by neither method is possible, but it seemed that in American practice the first method has been followed a little too strongly, and the second not quite enough. Mr. Lüpke pointed out the desirability of the heads of departments taking keen interest in

the work of their subordinates and of showing them by example quiet, enthusiastic and persistent devotion to duty for its own sake. The value of proper praise and of correctly placing blame was made clear. The tendencies have been toward excess in both directions. A calm and discreet balance along these lines is absolutely essential. The author closed his interesting paper with a suggestion that the Association, through its various branches, undertake the examination of employes and reward those found capable by the presentation of a certificate or diploma, as a National Electric Light Association fireman, engineer, or the like, whatever the case might be. This scheme, although it seemed radical, was believed to be of incalculable value, not only to the companies, but to the men themselves.

The report of the committee on state sections and company branches was presented by H. M. Searle, chairman. In this report the rapid progress being made in the organization of company branches was described in detail and the character of the work carried on by them made clear. The comparative backwardness of the affiliation of state organizations with the National Association was also explained.

In opening the discussion on this report, C. L. Edgar gave his opinion as being in favor of state sections rather than company branches. He personally believed that the organization of state sections should be pushed first. L. H. Conklin was strongly in favor of the company branches, and said that in Pennsylvania a great deal of good had been accomplished by affiliation with the national organization. The subject was also discussed by Dudley Farrand, D. B. Rushmore and C. N. Stannard.

W. S. Seelman, Jr., of the Edison Electric Illuminating Company of Brooklyn, said that of the 1,600 employes, but few came in contact with the heads of the company. The company branch gave an opportunity for the discussion of topics of common interest and also afforded a means for the discovery and recognition of men of capacity, which should not be overlooked. V. W. Mendehall, of the Utah Light and Power Company, said that in the inter-mountain district in particular a great deal of good could be accomplished if the several companies would organize company branches and in time form a geographical section. Harold Almert gave his experience in starting an industrial club in one of the companies in which he is interested. This met with such success that six other interests in the same city started the work. Weekly meetings are held for the discussion of general topics and monthly meetings for technical subjects.

John F. Gilchrist stated that there should be a better understanding of the relation between the state and the national association. There is a distinct field for state and company-branch effort. The desirability of company branches depends a good deal on the local situation. There is no doubt at all of their value to both the company and the employes in large companies, and there is no better basis for the establishment of company effort than in connection with the Association. In Chicago there is a very healthy company branch, and in it there had been aroused a great deal of enthusiasm over the election of two delegates to attend the present convention.

At the close of this discussion and just preceding the adjournment of the session, Frank W. Frueauff moved that a committee be appointed by the president to look into the matter of dues of the company sections.

TUESDAY EVENING SESSION.

The session on Tuesday evening was opened by the presentation of the proposed amendments to the constitution, including provisions for the special inclusion of company-branch members and the suggested changes in dues. It was moved that a committee be appointed to confer upon these resolutions and to report at a later session.

The paper entitled "Developments in Street and Park Lighting," by J. W. Cowles, was then presented. In this paper the author considered in detail the various types of lamps suitable for this class of lighting, their wattage, the kilowatt energy expenditure per mile, and methods of installation, including various types of fixtures. The height at which the lamp should be placed above the street or parkway was discussed at length for various conditions, such as urban and suburban streets and in parks and boulevards and also for display lighting. A large number of illustrations of posts and fixtures for street and park lighting were shown. They were declared to be typical examples, selected from various American and foreign cities. The question of street lighting is now securing considerable attention and very satisfactory progress is being made. The author sounded a warning against an unreasonable adoption of the slogan of "more light." Scientific principles should be applied in the spacing and location of street lamps in order that uniform illumination may be obtained. S. G. Rhodes of New York, in discussing this subject, favored the use of sixty-candlepower tungsten lamps for park illumination where the lights must be placed under the surrounding foliage.

The report of the lamp committee was presented by W. W. Freeman, chairman. It was declared that carbon-filament lamps are still the ones most used. Metallized-filament lamps are steadily growing in use, and a number of the larger companies are about to abandon entirely the use of carbon-filament lamps. About seventy-five per cent of the companies replying to the committee's inquiries have used tungsten lamps. Many companies are actively pushing the use of this lamp. All indications are that the use of tungsten lamps is very satisfactory. However, the committee believes that notwithstanding the high efficiency of tungsten lamps, the Gem metallized-filament lamps will remain the standard for at least several years. The committee looks for increased improvement in the tungstens and continually reduced cost as the production increases. There was recommended an open arrangement by central stations with their consumers for pushing the use of tungsten lamps on easy terms, and thus making possible an aggressive campaign for new business. The committee also recommended that the manufacturers' list prices be followed. As far as tests have progressed the committee reports that there is every indication that American-made lamps are equal, if not superior, to the foreign-made lamps.

Supplementing the committee's report, Preston S. Millar, of the Electrical Testing Laboratories, New York, described various lamp tests which were being made and exhibited a number of lantern slides, showing lamp performances.

In opening the general discussion on the lamp committee's report, F. W. Willcox made some suggestions as to the order in which central stations should take up the near-high-efficiency lamps. As a general rule the Gem lamp should replace the carbon lamps for places where the lamp is not used very frequently. The tungsten lamp should be used where the lamp is required for long-hour service and where a very efficient even though high-priced lamp is desirable. J. W. Cowles called attention to the statement in the report that only four per cent of the companies delivered lamp renewals

under a definite schedule. He indorsed the idea of the company establishing regular rates for such service, as the Boston Edison Illuminating Company had done for several years, and had found eminently satisfactory. Keeping up a good service certainly keeps the consumers satisfied. W. S. Seelman, Jr., said that the Brooklyn company had already established a rule discontinuing the use of sixteen and thirty-two candlepower carbon-filament lamps. They were using Gem lamps for both free and non-free lamp renewals. Farley Osgood of Newark, N. J., said that it had been found that systematic inspections of customers' sockets eliminated promiscuous renewals, and therefore was a benefit alike to the customer and the company. In reply to an inquiry, Mr. Cowles said that the cost of delivering lamps had been found to be about 1.4 cents per lamp, based upon the delivery of about 1,000,000 lamps. Mr. Freeman declared that in response to the committee's inquiries no dissatisfaction had been voiced in regard to either free or non-free renewal of carbon lamps with Gem lamps.

A paper entitled "The Manufacture of Incandescent Lamps" was presented by S. E. Doane, chief engineer of the National Electric Lamp Association. This paper dealt with the manufacture of carbon and of metallized-filament lamps only. The making of these lamps, however, was gone into in great detail, and samples were shown by means of which the various processes were made clear. In reply to a question, Mr. Doane said that the percentage of breakage was very difficult to determine. If all breakage could be eliminated the cost could probably be reduced some twenty per cent.

An address entitled "Quality of Light" was then delivered by Paul F. Bauder. The author submitted the results which had been secured from a large number of tests from which comparative data might be prepared for the proper selection of artificial light sources. Throughout this was a most comprehensive and interesting address and maintained the keenest attention and aroused the enthusiasm of all present.

Farley Osgood, in resuming the general discussion on lighting topics, particularly in relation to Mr. Cowles' paper, said that the use of flaming arc lamps in Newark had increased the use of current in the stores, as the high illumination of the interiors was made rather poor by comparison with the great brilliancy of the exterior lighting. Dr. Charles P. Steinmetz, in discussing Mr. Bauder's paper, declared that with both the gas lamp and the incandescent lamp we have almost no control of the color of the illuminant. The introduction of the flaming arc lamp has enabled us to determine just the kind of illumination as to color that we may desire. He believed that investigations should be carried further into a study of those lighting sources where the composition of the light-giving elements can be controlled. After a brief reply by Mr. Bauder the session was adjourned.

Full reports of the concluding sessions of the National Electric Light Association's convention will be published in the issue of June 12. A. A. G.

Special Illumination of New York at Hudson-Fulton Celebration.

New York city at the time of the Hudson-Fulton one - hundredth - anniversary celebration next October, will be lighted up as never before in history. Chairman William Berri and the members of the committee on illumination a few days ago visited all the historic points in the city which will be especially featured at the coming anniversary, and concluded the day by awarding to the New York Edison Company the contract for lighting the various streets and places around which interest will center. Following this, Arthur Williams of the Edison Company announced that he would undertake to festoon Fifth Avenue with lights, beginning at Washington Square and extending to Central Park. In all, there will be illuminated 150,000 separate lights in Fifth Avenue during the eight days of the celebration. In addition, all the borough halls will be especially illuminated, also the Washington arch in New York and the arch at Prospect Park in Brooklyn. Grant's Tomb will not be illuminated, out of consideration of good taste, but instead giant searchlights will be turned on the building which will bring it out in the strongest relief.

Mr. Williams made the suggestion that the people of New York city in general should co-operate with his company and light their residences and places of business in order to heighten the effect. The committee in charge, which lunched in truly Hudson-Fulton style at the Claremont, included among members and guests: William Berri, Frank W. Smith, W. W. Freeman, Capt. Henry C. Miller, A. A. Pope, Arthur Williams, E. E. Stoddard, T. I. Jones, C. G. M. Thomas, Henry C. Pain, William Parry, Norman G. Meade and Mr. Graham.

Wisconsin Utilities.

Preliminary valuations on Wisconsin street-railway, light, heat and power concerns aggregate $37,344,000 within the state, which will probably be reduced about $2,500,000. The tax is 1.43084076 per cent. The last previous valuation and the first one under the ad valorem system was $36,098,000, which was cut down to $33,932,000.

Preliminary valuation of the Milwaukee Electric Railway and Light Company is $22,000,000, or an increase of $750,000, and that of the Milwaukee Light, Heat and Traction Company is $5,600,000, or an increase of $700,000. The Milwaukee Northern's valuation is $1,675,000. Total taxes will approximate $50,000 or $100,000 more than last year.

Ready with Subway Plans.

It was reported on May 24 that the Bradley-Gaffney-Steers Company, which some time ago offered to the New York Public Service Commission to construct a subway system through Manhattan and the Bronx, New York city, at its own expense, following the offer of the Interborough Rapid Transit Company to extend the present subway system, has amended its offer so as to have it conform exactly with the Broadway-Lexington Avenue rapid transit route laid out by the Public Service Commission.

This places the Bradley-Gaffney-Steers concern in a position to take immediate advantage of the new Travis-Robinson law, if it is approved by Governor Hughes, permitting private capital to operate new rapid transit lines.

Railway Association Appoints Electricity Committee.

An evidence of the extent to which the railroads of the United States are taking notice of the possibilities of electricity as a substitute for steam is seen in the fact that the American Railway Association has decided to appoint a new committee on "electrical working."

As the objects of the association are "the discussion and recommendation of methods for the maintenance and operation of American railways," this move indicates that the railroads are keeping fully informed of the progress made by the pioneers in the electrification movement.

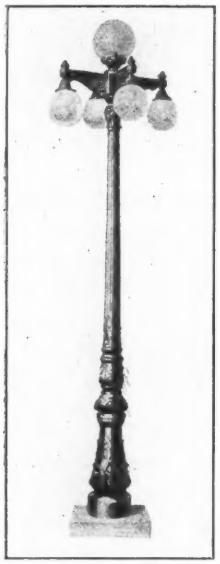
The electrification committee of seven members will be chosen by F. A. Delano, president, and the executive committee, subject to re-election at the next meeting in Chicago on November 17.

ORNAMENTAL CURB-LINE ILLUMINATION.[1]

BY D. F. FRADETTE.

Perhaps there is no subject interesting central stations all over the country more than decorative street lighting. From everywhere we hear of some central station that is installing a system of decorative street lighting, or is making efforts to establish one, and the question that often arises in their mind is, which is to be preferred, the arches, such as are used in a number of well-developed central-station territories, or a system of street lighting with poles, such as have been successfully installed in Oakland, Cal., where they have 600 three-light poles, each costing $85, and many other cities, until we come to Des Moines, which has in a short six months installed seventy five-light poles, a system decided upon after a close study of all methods of decorative street lighting. After the investigation, carried on by the local commercial association, and the Des Moines Electric Company, and also from the letters I have received from manufacturers and central stations all through the country, the consensus of opinion is that, for street-lighting purposes, the pole is the one most desired. Some of the advantages of the pole which I mention are: that it is less menace to fire fighters, the light is stronger, more concentrated and more evenly distributed on the walks, and from the standpoint of artistic beauty during the day, there is no question as to its superiority.

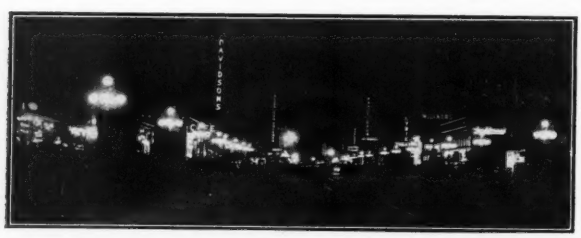
Des Moines, Iowa.—Before going into the matter of styles of poles, cost and methods of securing the business, I think it would be well to give a short outline of what we have accomplished in Des Moines, and following that with a comparison of the different methods used by other companies. We have in Des Moines a Commercial Club, or "Boosters' Association," which decided that the city streets should have some form of decorative lighting, and which, with the assistance of the local company, decided upon iron poles. The company then got prices and photographs of nearly every type of pole on the market and submitted them to the Commercial Club, which selected the type having one lamp at the top of the pole, and one inverted lamp on each arm, the inverted lamp being deemed best adapted to street lighting. After deciding upon the type of pole, probable cost of installing, and cost of lighting, the matter was then taken up with the City Council. They passed an ordinance making the type of pole selected by the Commercial Club the standard, and stating that the pole spacing should not exceed fifty-six feet nor be closer than forty-four feet. The casting of the pole costs $59; set up complete, and connected ready for the turning on of the lights, the pole costs $85. After this had been accomplished, it was then up to the electric company to follow with an active campaign, which was done with the very able assistance of committees of local merchants. Each group forming in its own block, endeavored to exceed the others in brilliancy. The success of the scheme was apparent almost at once, as there was little or no trouble getting the first seventy poles, and the more we got the easier it made the rest. As an instance of the willingness, and I might say, even the eagerness, of the merchants to light up, there is one block which we call the "400 block (Nos. 401 to 501), where, after the two blocks above



POST, DES MOINES, IA.

POST, SUPERIOR, WIS.

POST, LOS ANGELES, CAL.



ELECTRIC LIGHTING, WALNUT STREET, DES MOINES, IA.

ELECTRIC STREET LIGHTING, SUPERIOR, WIS.

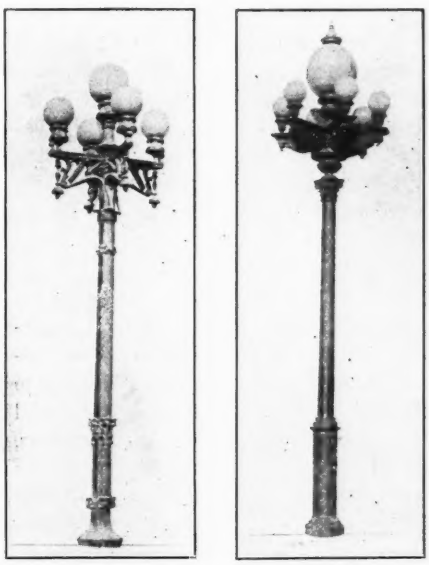
[1] Abstract of a paper read before the Iowa Electrical Association, at Cedar Rapids, Iowa, April 21, 1909.

it had installed twelve poles each to the block, in accordance with the ordinance, it was decided to install sixteen to the block, which is forty-four feet between lights. These were installed, and the additional poles made such a vast improvement, that we have now three other blocks following suit. In getting this kind of business it makes considerable work for the new-business department, but not nearly so much as would be supposed. For instance, only last month we were notified by two merchants in different blocks that they had been out soliciting, and requested us to submit contracts, and they would get them signed. This move was unknown to us, as these merchants had set about to improve their own block. This same spirit is shown by all. From this, I think you will agree, that it is not a difficult matter to get this business, once it is outlined.

SIXTEENTH STREET, DENVER, COLO.

Our method of charging for these poles and the lighting is to base each man's proportion according to his foot frontage; the property owner paying for the pole and installing it, and the tenant paying for the lighting. Up to date this method of charging has been perfectly satisfactory, and we are having no complaints. Each pole is equipped with a lock switch in the base, and the flat-rate lamps (windows, signs, and poles) are turned on by the patrolman, as he makes his rounds, and turned off at 12 p. m. Our rate per year for lighting each pole equipped with five 100-watt tungsten lamps is $69.50. I think I have covered pretty well the subject of decorative street lighting as they do it in Des Moines, and I will now give a short account of the methods used by some other successful cities.

Los Angeles, Cal.—In this city the scheme originated with the merchants on Broadway, who organized, and, with the assistance of the electric company, as in our case, installed poles costing $100 each complete. Soon after the installation of poles on Broadway, the merchants on Spring and Main streets also organized, and they too had the assistance of the electric company. Each street had its own type of pole, but, as you will note from the photographs, there was no material difference. The poles were placed 115 feet apart, on both sides of the street. In each of the balls shown there are three eight-candlepower lamps. An attempt was made to use tungsten lamps, but it was a failure, as the jarring from the passing cars broke the filaments. I might here add that we have had no such trouble with our lamps, which are 100-watt tungstens, and are giving perfect satisfaction. The Edison Electric Company, of Los Angeles, Cal., called our attention to one defect in the pole installed by it, which is, that the middle ball should be raised at least six inches, otherwise it will give the post a squatty appearance, and the large center globe will be almost obscured. I have seen poles having this same defect, and it would be well to guard against that when deciding upon your design.



ORNAMENTAL POSTS IN LOS ANGELES, CAL.

The lighting of these poles is paid for by the city, the castings by the merchants and property owners, and the cost of installing by the electric company. The circuits are so arranged that all of the poles give forth their illumination until midnight, after which all are turned off but two corner poles, which are left burning all night.

Oakland, Cal.—In this city there are now installed over 600 three-ball posts, and each ball contains three sixteen-candlepower lamps. These posts are placed three on each side of the street, or six to the block, and the cost of each pole is approximately $85 set up complete. The solicitation and installation was done by a private contractor. The cost of installing was borne by the merchants. The lighting is paid by the city. This opens up another scheme, for, as Oakland has done, could not some contractor be induced to interest the merchants and city in this method of lighting? The Oakland Gas Light and Heat Company calls our attention to a defect of its pole, in that the globes being turned upward, the light is very unsatisfactory. This is another item worth watching. The pole used in Oakland, with the two side globes turned downward, should be well suited to the smaller cities, as the pole is not of expensive construction, and one sixty-watt or 100-watt tungsten in each globe would be an economical and very attractive system.

FIFTEENTH STREET, DENVER, COLO.

Denver, Colo.—In this city there is an entirely different arrangement, but a very novel and attractive one. It was the result of co-operation between the Electric Railway, Electric Light Company, and the city. Here, as you will note from the photograph, they have used the trolley pole, over which was put a square ornamental casing in order to cover the slant, which was supposed to be necessary to offset the strain of the railway span wires. On each pole are two brackets, one extending over the street, and one over the walk, from which are suspended two arcs. There are 113 of these poles on Sixteenth Street, spaced ninety feet apart on both

sides of the street, or four pairs of poles to the block. The casing of these poles cost $160 and was paid for by the city. The lighting is also paid for by the city at a cost of $60 per arc per year. On Fifteenth Street no casing was necessary, as the trolley company allowed the poles to be straightened and a bracket costing the city $50, holding only one arc, was paid for by the city. There are 123 of these poles on Fifteenth Street, spaced as on Sixteenth Street.

Superior, Wis.—Here the matter of deciding on the system to be installed, style of pole and soliciting of the same was done by the Publicity Committee, the local electric company installing the poles as requested. Superior has installed a three-lamp post. The side lamps are 100-watt tungstens, and the top lamp a forty-watt tungsten. These poles are so wired that the side lamps may be turned off at 12 p. m. and the small middle lamp is left burning all night. The poles are spaced about fifty-five feet on both sides of the street, or sixteen to a block, and the cost per pole has averaged $80 complete. These poles are lighted from an independent circuit set in a groove, which was chipped from the edge of the cement walk.

This same system of connecting the poles by setting a conduit in a groove chipped from the edge of the walk seems to be the most popular, but many have done as we have in Des Moines, merely fished wire under the walk and connected to the nearest feeder, each pole being turned on by a lock switch in the base. Regarding the size of balls that best diffuse the light, I would not recommend one of less than fourteen inches in diameter, as this seems the most popular size, and I have not yet seen any that were too large.

Navy Department Supplies.

The Bureau of Supplies and Accounts, Navy Department, Washington, D. C., will open bids, on June 8, for 2,500 feet steel-enameled conduit, for delivery at Boston, Mass.; one electrical deck winch, for delivery at Charleston, S. C.; miscellaneous electrical wire and cable, insulator hangers, iron conduit straps, for delivery at New York city; and miscellaneous electrical fans and spare parts, for delivery at Philadelphia, Pa.; on June 15, for miscellaneous electric apparatus for fire control, for delivery at various navy yards; on June 29, for one electric traveling hoist and one electric elevator, for delivery at Mare Island, Cal.

A New Electric Furnace Installation.

The American Electric Furnace Company of New York city, which controls the Kjellin, Colby and other induction-furnace patents in this country, has erected a demonstration plant at Niagara Falls. This includes three furnaces, a ten to twenty-kilowatt laboratory type, a forty to sixty-kilowatt experimental type, and a 100 to 150-kilowatt small commercial type steel furnace, together with the ladles, ingot molds, and other necessary casting arrangements.

The induction furnace, as its name implies, operates on the transformer principle, the metal to be melted forming the secondary circuit. The metal is contained in an annular trough or crucibile. Concentric with this is the primary, which consists of a coil of wire wound on a laminated core, in the Kjellin furnace. A laminated yoke connects the two extremities of the core passing over, behind and below the trough. An alternating current passed through the primary induces a current in the metal in the trough which causes the metal to become heated and quickly fused.

This kind of furnace obviously opens up new possibilities not hitherto attainable with crucible furnaces or with electric furnaces using electrodes. Owing to the non-introduction of foreign material of any kind during the melting process, the resulting product may be absolutely predetermined as to its chemical constituents, both in kind and proportions, by charging the furnace with constituents of a known analysis. The oxidizing effect of the air and the loss of the more easily volatilizable constituents of the charge may be prevented by luting down a cover on the crucible.

In the Niagara Falls installation power is obtained from the Canadian Niagara Power Company. The current for the largest furnace is stepped down by a transformer to a normal potential of 525 volts. By the use of an induction regulator and a five-point contact connected to taps from the primary coil of the transformer, both in series with the transformer, this may be varied from 475 to 600 volts. Three-phase current is obtained from the power company, and the power-factor is raised from a figure of between sixty and seventy per cent up to eighty per cent by connecting up a synchronous motor to one of the legs of the circuit.

The performance of the furnace, apart from its excellent metallurgical features, is decidedly economical. The power cost is low and labor cost is greatly minimized. In a particular test of the furnace 910 pounds of steel were charged and melted in sixty-eight minutes and poured in ninety minutes, the residual bath from the previous charge being 850 pounds. The power consumption worked out to 440 kilowatt-hours per gross ton. Another test with a charge of 1,000 pounds gave 560 kilowatt-hours per gross ton.

Gas and Electric-Light Companies' Stock.

The Boston Committee on Public Lighting has reported in the Senate today a bill authorizing gas and electric-light companies in issuing their capital stock to have the price of the same determined by their directors. This places these companies on the same basis in this respect as the railroad corporations, which last year, by a special act, were so authorized to fix the price of new issues of their stock.

The report of the public lighting committee on price of new stock issued by gas and electric-light companies provides that any gas and electric-light company shall, upon increase in its capital, offer new shares proportionately to stockholders at such price not less than par as determined by directors.

Such shares shall be offered in Boston or in other city or town as prescribed by the gas commission, and notice of time and place shall be published at least five times during the ten days preceding. No shares shall be sold or issued under this or the preceding section for a less amount to be actually paid in cash than the par value.

New York Bridge Loop Subway.

The $10,000,000 bridge loop subway, which is to connect the Brooklyn and Williamsburg Bridges with a spur to the Manhattan Bridge, is said to be practically completed, with the exception of the southernmost section connecting with the Brooklyn Bridge.

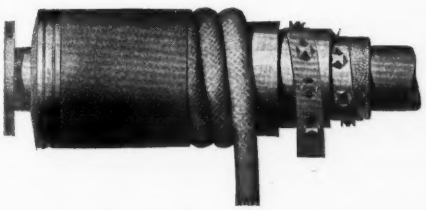
That section as planned is to have a station underneath the new Municipal Building, at Centre and Chambers streets and Park Row. The station cannot be put in until the foundations for the building have been laid, and some months ago, at the suggestion of Mayor McClellan, the Public Service Commission had work on this section stopped. The contracts of the contractors on the other sections originally called for the completion of the work by the first of last January, but the Public Service Commission extended them until August 1.

THE DESIGN OF STEAM-ELECTRIC POWER PLANTS.

BY FRANK KOESTER.

PIPING.

Flexibility in a main and auxiliary steam-piping system is of the utmost importance for the continuous operation of a plant. In connection with flexibility, simplicity of arrangement is vital. The main pipe connections to the boilers may be of the single or double-header systems and the ring system; of these, the single-header system is the one most generally employed because of the present high standard of material, which is now relied upon to reduce the possibility of breakdowns. The size of pipes must be calculated to give a velocity of about 7,000 feet for saturated steam and about 9,000 to 10,000 feet for superheated steam, depending upon the temperature. High velocities for superheated steam are used because this steam more closely re-



PASQUAY PIPE COVERING.

sembles a fixed gas, and therefore it is not as much affected as to friction as is saturated steam.

With a high temperature of steam a greater amount of expansion of the pipes must be taken care of. The only proper method for taking care of the expansion is the use of large radius bends. The radius must be at least five times the diameter of the pipe in order to prevent buckling of the pipe in the bending of the same. Anchors must be placed in proper places to distribute this expansion equally in both directions and to minimize the vibration.

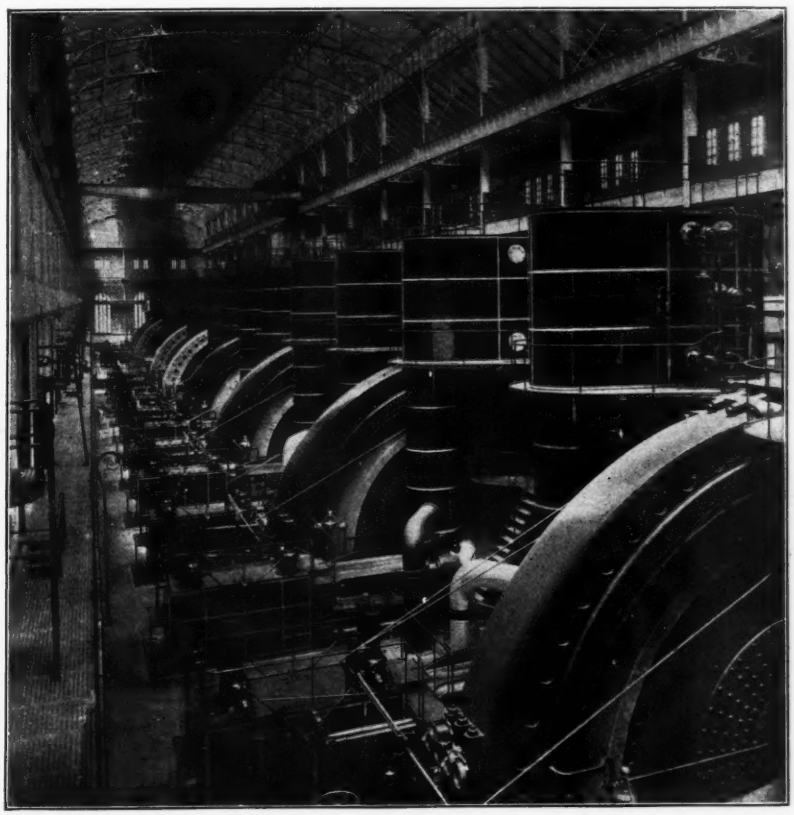
It is one of the essentials in modern power-plant practice to do away with cast fittings as far as possible, and these should be replaced by welded steel or iron pipes with outlets and flanges welded to the pipe itself. Different outlets may be welded in a single length of pipe, doing away with the necessity of cutting the pipe into sections and inserting fittings. This not only reduces the number of fittings, but also reduces the liability of leakage, as the number of joints is reduced. The welding of fittings and other pipe outlets is carried out either by purely electrical, by the oxy-acetylene or by the oxy-hydrogen processes.

Piping for supplying steam to auxiliaries should have a separate header system.

In calculating the size of the atmospheric exhaust piping, a velocity of from 5,000 to 6,000 is figured, while in the connections to the condenser a velocity up to 30,000 feet is frequently chosen. This high velocity is due to the rarity of steam under vacuum; for instance, one pound of steam under a vacuum of twenty-four inches occupies 118 cubic feet, while at three pounds gauge pressure one pound of steam occupies a space of 21.5 cubic feet.

In running pipes for conveying steam under partial vacuum it goes without saying that the runs must be made as short as possible. This is particularly essential in steam-turbine installations, where high vacuums are maintained. Some turbine installations have been made in which vacuum pipes of rectangular area have been used, the manufacture of which necessitated the use of countless rivets, each rivet adding to the possibility of leakage and consequent loss of vacuum. In fact, in such construction it is difficult and next to impossible to maintain a vacuum greater than twenty-eight inches. It is good practice not only to make the connection between turbine and condenser as short as possible, but also to employ but one or two flanges; such flanges are sometimes water-sealed.

Care must be exercised in reducing the friction in all vacuum pipes as well as circulating water pipes to make all bends of long radius wherever possible. In low-pressure lines expansion may be taken up either by slip joints or other special expansion joints.



FIFTY-NINTH STREET POWER PLANT, NEW YORK, SHOWING HIGH-PRESSURE SIDE OF NINE 5,000-KILOWATT ALLIS-CHALMERS ENGINES.

Pipe covering, both for high and low pressure, must be of about eighty-five per cent efficiency, there being a number of makes which come up to this standard. A pipe covering of extraordinary efficiency (ninety-five per cent) is frequently used on the Continent of Europe. This style of covering is shown in an accompanying illustration.

That the same standard quality of material may be used throughout a station the quantity applied differs for high-pressure and low-pressure work.

PRIME MOVERS.

The selection of prime mover, whether reciprocating engine or turbine, may be

considered a matter of opinion. Each has its advantages and disadvantages. The questions to be considered in the design of power plants are: First cost, continuity of operation and low steam consumption. Whatever be the selection, whether reciprocating engine or turbine, the prime mover must be designed to withstand a fair degree of superheat, by which is understood at least 150 degrees Fahrenheit of superheat. European engineers consider that high degree of superheat covers temperatures of from 250 to 300 degrees of superheat, and in exceptional cases 350 degrees Fahrenheit of superheat are employed.

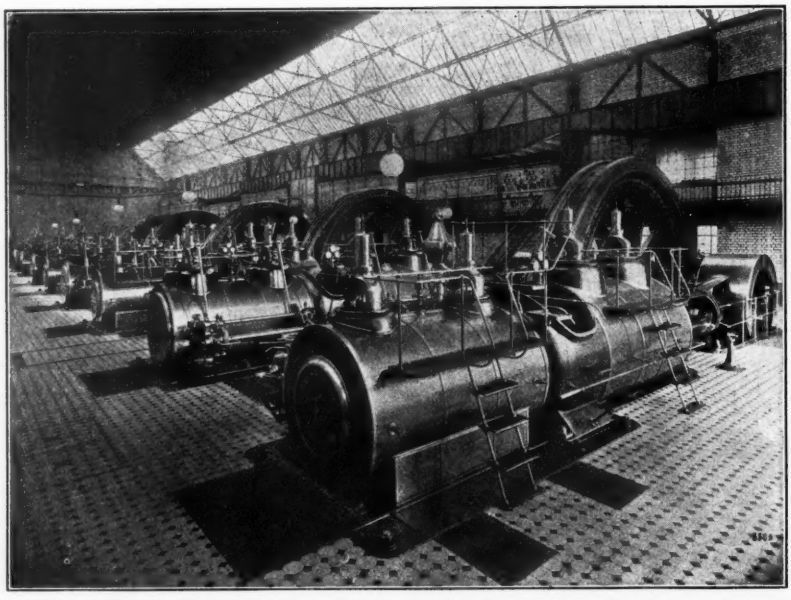
As already pointed out under the heading of superheaters, the saving in steam consumption is considerable, and in order to show more clearly the gain at different degrees of temperature of superheat, the following table will be of interest, representing the steam consumption in pounds per indicated horsepower-hour of a 3,000-horsepower Sulzer engine, as installed at the "Louisen Strasse" plant in Berlin. The tests were with a gauge pressure of 195 pounds at the throttle, where the temperatures were also measured.

TABLE VI.—GAIN IN STEAM CONSUMPTION DUE TO SUPERHEAT.

Saturated steam.....	Temp 385° Fahr.	11.56 lbs.
130° Fahr.....	Total temp. 565° Fahr.	10.13 lbs.
237° Fahr.....	Total temp. 623° Fahr.	9.50 lbs.
265° Fahr.....	Total temp. 650° Fahr.	9.41 lbs.

The engine is of the four-cylinder, triple-expansion type. The high-pressure cylinder is thirty-four inches, the intermediate cylinder forty-nine inches, and two low-pressure cylinders sixty-two inches, thus giving a ratio of 1:2.1:6.2, the stroke being fifty-two inches, and revolutions 83.5 per minute.

During the past two years, both as to reciprocating engines and turbines, some remarkable instances of low steam consumption have been recorded, viz.: a 7,500-horsepower, twin-compound engine at the Fifty-ninth Street plant, New York, 11.9 pounds per indicated horsepower-hour; 7,500-kilowatt Parsons turbine at the Williamsburg plant, 14.9 pounds per kilowatt-hour; 5,000-kilowatt Curtis turbine at the L Street plant, Boston, 13.5 pounds per kilowatt-hour; 9,000-kilowatt Curtis turbine at the Fisk Street plant, Chicago, 12.9 pounds per kilowatt-hour.



INTERIOR OF A PLANT IN BERLIN, SHOWING ONE 6,000-HORSEPOWER AND FOUR 3,000-HORSEPOWER SULZER TRIPLE-EXPANSION ENGINES.

An interesting report of a test at the new Bennings plant, courteously furnished by L. E. Sinclair, general superintendent of the Potomac Electric Power Company, Washington, D. C., showing not only the steam consumption, but also other items, which will be of interest to the power-plant designer, is as follows, the plant consisting of two 5,000 and two 2,000-kilowatt Curtis turbine units:

Steam consumption per kilowatt-hour	14.13 lbs.
Pressure at boiler	180 lbs.
Pressure at turbine	175 lbs.
Temperature of superheat at boiler	160° Fahr.
Temperature of superheat at turbine	120° Fahr.
Temperature of feed water (open heater)	190° Fahr.
Temperature of flue gases	450° Fahr.
Coal consumption per kilowatt-hour	2.2 lbs.
British thermal units per pound of coal	14,500
Cost per kilowatt-hour at the bus-bars	57 cents

While these are remarkable figures, the manufacturers do not guarantee such low steam consumption. In order to obtain still better results it would be desirable that the manufacturers guarantee a steam consumption on the basis of the above showing, which, in order to secure a desirable margin for themselves, would spur them to do still better.

The size of individual prime movers depends upon the size of the plant, and in selecting the number of units care must be exercised, that there may be one or more units held in reserve. It is customary to install prime movers of as large a capacity as possible. In reciprocating engines the limit in size of individual units has probably been reached with the 5,000 to 5,500-kilowatt units now used, but with turbines it will probably not be long before even 14,000-kilowatt units will be exceeded. At present there are several units in use at the Quarry Street station, Chicago, of 14,000 kilowatts maximum capacity for continuous operation. Several views of these units were shown in the last issue.

The fluctuation of load, particularly for railway and lighting service, demands a large number of reserve units. In order to reduce the number of such reserve units, American designers have introduced prime movers capable of standing an overload of fifty per cent. This practice is peculiar to this country, a few exceptional cases occurring in Great Britain, while none at all are known on the Continent, where prime movers are sold to carry an overload of only twenty to thirty per cent. Largely on account of their high economy at what would ordinarily be regarded as overloads, one of the largest American turbine builders has recently begun to rate its turbines at that maximum capacity which they can safely maintain in continuous operation.

It is the writer's opinion that prime movers designed for fifty per cent overload are in reality underrated. The horsepower at which a prime mover is rated must be that at which it operates most economically. Practice frequently shows that prime movers rated for fifty per cent overload operate most economically when the overload is twenty per cent. It will thus be seen that a prime mover operating at its normal rated capacity would mean a loss in economy. Therefore its rating should have been raised.

CONDENSERS.

High vacuum is essential, particularly in the use of steam turbines, to secure economy in steam consumption. Practice with some types of American prime movers has shown that for each inch of increase of vacuum the steam consumption will be reduced about one pound. It must be remembered that the higher the vacuum is carried the larger the condensing apparatus necessary. The amount of condensing water required may be figured from the following formula, in which I = temperature of supply water.

D = temperature of discharge water.

S = total heat (sum of sensible and latent heat) of the steam at the pressure at which it leaves the engine.

Then $\frac{S-D}{D-I}$ = unit weights of supply water.

This applies both to surface and jet condensers.

As already stated, the condenser should be placed as close to the turbine as possible, preferably adjoining same, an instance of which is found in the Curtis base-condenser type of turbine. The disadvantage of an arrangement of this kind lies in the fact that when the turbine exhausts non-condensing the circulation of water in the condenser must continue in order that the packing around the tubes remain in good condition.

The pumps must be arranged convenient to and preferably around the condensers for convenience in operation, and each condenser should have its own circulating water pump, air pump and hot-well pump (where such pumps are required), in order to carry out the complete unit system. Vacuum breakers must be used on the piping to the air pump to prevent the engine from running away with a large vacuum on the exhaust end when the load is thrown off.

The question as to whether steam or motor-driven auxiliary machinery should be installed, depends upon the equipment of the plant. Where economizers are installed to insure the heating of the boiler feed water to a high temperature, motor-driven auxiliaries should be used. Where the exhaust steam is used for heating the boiler feed water, it is desirable to use steam-driven auxiliaries to the extent that such exhaust steam may be required. Any further auxiliaries should be motor-driven, as these are more efficient.

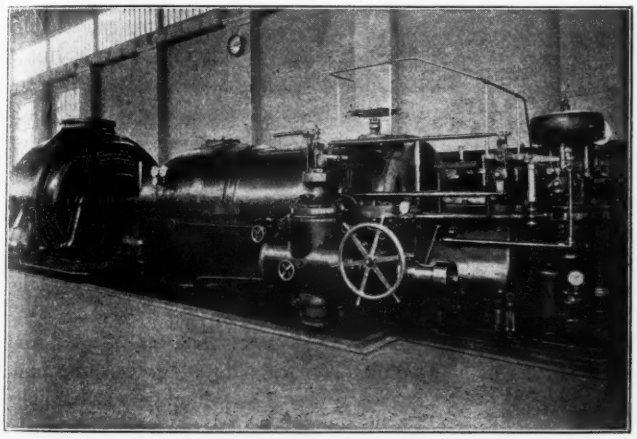
The average steam consumption of both piston and plunger pumps for all steam-driven auxiliaries may be assumed to be fifty pounds per indicated horsepower. In motor-driven auxiliaries, assuming that the efficiency of the generator, motors, transformers, etc., is eighty per cent, and assuming that the current taken from the busbars is supplied by the generator unit at thirteen pounds, the equivalent steam consumption is 15.6 pounds.

The steam consumption of the combined auxiliaries of a plant varies from three to seven per cent of the total output of the plant. There are exceptionally few cases in which it will be below the first figure, while there are more in which it will run above the latter figure. The following table shows fair average figures:

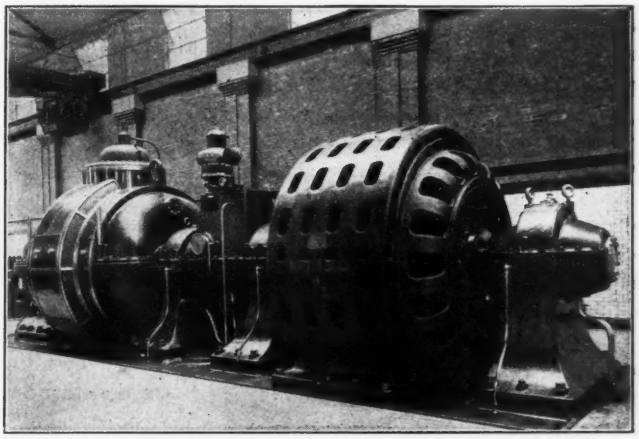
TABLE VII.—AVERAGE STEAM CONSUMPTION OF AUXILIARIES.

	Per Cent
Circulating pumps	1.5
Air pumps	0.8
Hot-well pumps	0.3
Boiler-feed pumps	1.5
House pumps	0.4
Oil pumps	0.6
Exciters	0.5
Total	5.6

[To be continued.]



5,000-KILOWATT BROWN-BOVERI-PARSONS TURBINE, ST. DENIS STATION, PARIS.



3,500-KILOWATT BRITISH WESTINGHOUSE TURBO-ALTERNATOR, NEARDEN POWER PLANT, METROPOLITAN RAILWAY, LONDON.

Metropolitan Telephone Petition Dismissed.

The full bench of the Massachusetts Supreme Court has dismissed the petition of the Metropolitan Home Telephone Company for a mandamus to compel Superintendent of Streets Emerson, of Boston, Mass., to grant a permit to open up certain streets for laying wires.

The order of the Board of Alderman for laying of the wires of the Metropolitan Home Telephone Company, which the Supreme Court refuses to order the superintendent to obey, gave that company rights in more than 200 streets, and the company claimed that the duty of the superintendent was only ministerial, and did not confer the right to set aside the order.

Time for Wheel Guards Extended.

At the regular meeting of the New York Public Service Commission held May 25 the Metropolitan Street Railway receivers were granted an extension of time in which to equip their cars with wheel guards. This extension was the result of a rehearing after the commission issued its final order for wheel guards. The original order required the company to install fenders by August 15, and this time is now changed to July 15 for 500 closed cars and October 15 for all.

United Railways of St. Louis Loses Suit.

The Court of Appeals at St. Louis, Mo., has handed down a decision in the Barrie case, holding that the United Railways Company of St. Louis is liable for indebtedness of St. Louis Transit Company. The decision is regarded as rendering the company liable to damage judgments amounting to $1,500,000.

The Extension of Electric Service to Outlying Communities.[1]

The progress of the electrical art and the education of the general public have made it possible today to profitably supply electric service to communities whose size would have rendered such service out of the question but a few years ago.

Within the states of Iowa, Minnesota, Wisconsin and the Dakotas there are today 670 central stations. Thirty-nine per cent of these are in towns of 1,200 inhabitants or less. Further than this, there are 188 towns of over 600 inhabitants which are not supplied with electric service.

It is safe to predict that within the next five or ten years, nearly all of these 188 towns will be supplied with electricity. While it is said that electric power properties in such small communities are not good investments, this statement is not borne out by facts. Many such properties are making excellent returns, and it is unquestionably a fact that they are as successful as any other industry in the communities where they are located.

The last central-station guide adds 210 names to the list of operating central stations, forty of them in states above referred to. Eighty per cent of these new plants are started in the smaller towns and villages, and every plant so started begets inquiries and discussion as to the advisability of establishing service in other communities of like size. The interest is widespread and vital, for each year people demand more conveniences; and those which ten, or even five, years ago were regarded as luxuries, are today necessities, even in the smallest communities.

While there can be little or no doubt that these 188 communities will, in the near future, demand electric service, it rests entirely in the hands of the station manager of today as to whether this service shall be supplied from existing central stations, or whether new central stations shall be installed. Some of these towns and villages are so isolated as to lie utterly beyond reach of existing central-station lines, but at least sixty per cent of them are so located as to merit careful consideration as substation possibilities.

The extension of electric service to outlying cities and villages has been taken up systematically by a number of central stations during the past few years. That business obtained in this way is profitable is best shown by the fact that year after year they reach out to new and more distant communities, increasing their distribution zone and bringing more people within reach of electric service.

As yet, however, this method of increasing central-station load has not received the consideration at the hands of a large number of central-station managers which it merits.

Up to the present time two general plans for supplying outlying communities have been used with success.

The first and simplest method is the formation of a local company in the community to be served, and the supplying of power to this local company at wholesale rates from the transmission lines of the central station. This plan has much to commend it. From the viewpoint of the community served, it makes the local company a matter of local pride; built by local capital, managed by local men, with the bulk of the revenue being put directly back into local circulation. From the viewpoint of the central station, such an arrangement removes the burden of franchise getting, maintenance, repairs and operation, and reduces the amount of capital which must be put into the enterprise to the bare cost of the transmission line. The material reduction in first cost makes the plan particularly attractive to the smaller central stations and to those who for any reason do not feel inclined to increase materially either their invested capital or operating expenses.

On the other hand, the local companies in the communities so served stand as individual customers buying current at a low or wholesale rate, for which reason the gross revenue to the central station is less than it would be were the same amount of current sold at retail rates. Whether or not the net revenue is also less is a matter for debate and individual consideration. Further, the local company may, at the expiration of its contract, elect to buy power from some other source, and for this reason it is often well to arrange for an option on a controlling interest in the stock, or if this is impossible, at least for a long-term contract.

The second method of approaching these situations may be termed a straight substation proposition, the central-station company owning pole lines and distributing systems and operating them as part of its own plant.

In estimating whether or not the returns from any particular community will justify the supplying of that community with power, detailed consideration should be given to the following factors:

1. Revenue—
   a. Street lighting.
   b. Commercial lighting.
   c. Power.
2. First Cost—
   a. Franchise and right-of-way.
   b. Transmission line.
   c. Local distribution.
3. Operating Expenses—
   a. Depreciation, taxes and insurance.
   b. Cost of power.
   c. Maintenance and repairs.
   d. Bookkeeping.

A fairly close estimate of revenue may be made by comparing the possibilities with those of similar communities already served. In making an estimate of probable returns, however, the rapid progress in the art must not be underestimated. With the advent of the tungsten lamp, commercial lighting has increased and customers heretofore unapproachable have been added to central-station lines. If a day service is maintained, farms along the transmission line should be equipped with motors. There is no section of the country where the rural population is so progressive as in your own, and they may be relied upon to take advantage of the rapidly increasing conveniences which are made available by the advent of electric service.

It is difficult to make any general remarks upon the subject of franchise and right-of-way. The community as a whole may be relied upon to welcome any proposition which contemplates increasing its comforts and the advantages of its town. While difficulties are sometimes experienced with some of the so-called town fathers, who, from one motive or another, believe it to be their duty to attempt to hold up all public-service corporations, the local authorities will, as a rule, meet the situation more than half way.

It has been pointed out by those who have had large experience in these matters that it is always well in obtaining such a franchise to specify that power may not only be carried to the community which it is proposed to serve, but also through it in order that there may be no question raised if in future it becomes expedient to serve other communities beyond this particular town. For obvious reasons it is also well to specify and speak of transmission lines as long-distance rather than high-tension distribution.

Right-of-way privileges are, as a rule,

1. Abstract of a paper by J. S. Knowlson, presented before the seventeenth annual convention of the Northwestern Electrical Association at Milwaukee on January 21, 1909.

obtained along highways, but when poles are placed on private property, written permission should always be obtained, or a nominal rental paid to avoid any possibilities of future friction.

In considering the transmission line, the first attention must be directed to the determination of a suitable voltage. Copper is always a considerable item, and the generating voltage should be stepped up, when the saving in copper thereby obtained will equal or exceed the cost of suitable transformers.

Line costs vary with the local condition, but for construction of this sort the simplest form is best. Thirty-foot, and often twenty-five-foot, poles are used, each pole carrying a two-pin cross-arm, and the third wire, if a three-phase circuit is run, being carried by a pin insulator on top of the pole.

If it has been necessary to use a pressure higher than 2,300 volts on the transmission line, this voltage should be stepped down through a bank of transformers located on the outskirts of the town, the transformers, protective fuses and lightning arresters being mounted in the simplest manner on poles.

In the local distributing system, the street lighting demands primary consideration. This lighting will probably be done by incandescent lamps, either of the street series type, or multiple. The series system will undoubtedly give more satisfaction, but it necessitates a transformer and some place to keep it. Local conditions will also readily determine this point.

While the first costs of construction are comparatively easy to estimate, it is in the operating and maintenance items that opportunity arises for the ingenuity of the central-station man to devise methods by which this semi-isolated load may be operated most economically.

Arrangements are often made with some local storekeeper to carry incandescent lamps and supplies, and in return for the current consumed by him to take charge of routine attendance, such as switching the street circuits on and off, together with the care of such slight troubles as replacing fuses, street lamps, etc. Further arrangement is often made in the same way for the reading of meters and the collection of bills on a commission basis. In other localities, the control of the street-lighting circuit is automatically taken care of by means of a time-clock switch which only needs to be wound up once a week.

Bookkeeping and office expenses may be somewhat reduced by providing the meter reader with a manifolding bill book, having the meter reading recorded in duplicate, the reading multiplied by the rate and the original being left with the customer as his bill, while the copy is brought back to the office for file. The methods are legion, for wherever we find Yankee business men we will find new and improved schemes for decreasing cost and increasing efficiency.

Although general figures are often misleading, and as a rule to be avoided in discussions of this sort, I present for your consideration the following table of data on transmission voltage, capacity, necessary outlay, and margin of safety and profit which may be expected from substations in town of various sizes at various distances from the central station:

Population Served.	Capacity of Substation.		Distance Substation from City Limits.			
			Three Miles.	Six Miles.	Nine Miles.	Twelve Miles
500	25 KW.	Transmission	2,300 V. 3-phase.	2,300 V. 3-phase.	.....	.....
		Total investment	$4,800	$7,500	.....	.....
		Margin of safety and profit	11.5%	3.7%	.....	.....
1,000	60 KW.	Transmission	2,300 V. 3-phase	11,000 V. 3-phase	11,000 V. 3-phase.	11,000 V. 3-phase.
		Total investment	$7,600	$10,000	$12,000	$14,200
		Margin of safety and profit	21%	13.5%	10%	5.5%
1,500	100 KW.	Transmission	2,300 V. 3-phase	11,000 V. 3-phase.	11,000 V. 3-phase.	11,000 V. 3-phase.
		Total investment	$10,000	$12,200	$14,000	$16,300
		Margin of safety and profit	25%	18.7%	13.9%	10%

Total investment includes transmission, fifty poles to mile, transformers, meters, street lights and distributing system completely installed. Cost of poles, cross-arm pins, insulators, etc., set ready to receive wire $9 per pole. Energy loss in transmission, five to ten per cent. Gross income from all classes of service, estimated at $4.50 per capita. Depreciation, insurance and taxes, ten per cent of total investment. Maintenance and labor, fifty cents to $1 per capita. Cost of power at generating station. Busbars, 1.5 cents per kilowatt-hour, does not include depreciation, insurance, etc. Consumption of energy as recorded on station meters, 100 to 120 kilowatt-hours per year. Margin of safety and profit, expressed in per cent of total investment.

While these figures may serve as a guide in a very preliminary survey of the latent possibilities, the point which I desire to make most strongly is that there are large possibilities for the profitable extension of electric service for outlying towns and villages, that these possibilities merit the consideration of the small central stations as well as the large, and, further, that the issue is one of today.

Each day the demand from these communities for electric service is becoming more insistent, and as new small generating stations spring up, the opportunities for extension of central-station lines are disappearing.

Electric Fire Hazards.

The following is the minority report of the executive committee of the New England Insurance Exchange on the electric risk question:

"We wish our associates to understand the reluctance with which the dissenting members of the executive committee feel called upon to make a minority report for the first time in the history of this organization, but we are constrained so to do because the recommendation of the majority is itself unprecedented, the object sought being against the practice and the purposes for which the organization was formed, which practice has maintained it successfully for more than twenty-five years. We recommend, therefore, that the supervision by this Exchange of rates and rules relating to electrical risks be not delegated to a central rating committee, as proposed."

At the semi-annual meeting of the Philadelphia Fire Underwriters' Association the proposed amendments to the by-laws excepting electric railway risks from the mandatory application of the association schedules were rejected. It was believed by some of the members of the association that the adoption of the amendments as proposed might be held to imply the abrogation of existing rates on such risks, or to submit the executive committee to pressure in the direction of taking immediate action to rescind or modify some rates on the class in question without reference to the central committee which is to be organized.

B. E. Blanchard, electrical inspector of the Chicago Board of Underwriters, who recently addressed the Fire Insurance Club of Chicago at the board rooms on various phases of his work, spoke principally on the hazards of interior wiring.

QUESTIONS AND ANSWERS.

STARTING A SYNCHRONOUS MOTOR.—Kindly explain to me the method of starting a 710-kilowatt, 2,300-volt, three-phase, synchronous motor without using the starting motor.—J. M. W., Portsmouth, Va.

If there are no means available for starting the motor mechanically, such as by belt or gearing from some power-driven shaft, the synchronous motor may be started as an induction motor by connecting the armature to the polyphase source and leaving the field circuit open till the motor is up to synchronous speed. In doing this, however, the load to be driven by the motor must be disconnected from it till at synchronism it may be connected by means of a friction clutch or magnetic clutch; if the motor drives a generator direct-connected to it, the generator must be left on open circuit till full speed is attained; this precaution is necessitated by the fact that even at no load a large synchronous motor takes a very large lagging armature current when started in this way, since it has but a small starting torque, and this abnormal current causes too serious a disturbance to the line potential. To minimize this disturbance it is desirable to use a starting compensator, which is an auto-transformer, to reduce the line voltage applied at first to about one-half of the normal value; this is the same practice as made use of in starting a regular induction motor; as soon as the motor comes up to an intermediate speed the connection is thrown over to give full line voltage, at which the motor quickly runs up to synchronous speed.

OHMS, METERS, ETC.—A. What constitutes an ohm? A megohm? What does an ohm represent? Has voltage and amperage anything to do with an ohm? How many ohms resistance does the human body possess? From what language does the word ohm come? B. In testing a house meter with a Westinghouse master meter having a constant of two-thirds, the house meter has a constant of 1.25; after running one minute the master meter records forty revolutions; how many should the house meter make? Kindly explain the use of a Westinghouse integrating meter when testing house meters and how to check up house meters properly. C. If I know the load a certain building will require, how can I find the number of circular mils a copper wire must contain in order to carry this load? —B. W. F., St. Louis, Mo.

A. An ohm is defined as "the resistance offered to an unvarying electric current by a column of mercury at a temperature of melting ice, 14.4521 grammes in mass, and having a constant cross-sectional area and a length of 106.3 centimetres." A megohm is equivalent to 1,000,000 ohms. An ohm is the practical unit of resistance. It is independent of the voltage and amperage of the current; however, it may also be stated as the resistance of a circuit through which passes an ampere of direct current at a difference of potential at the terminals of the circuit of one volt; the number of ohms resistance in a circuit is calculated by dividing the voltage at the terminals of the circuit by the amperes of current flowing through it. The resistance of the human body varies with the age and physical condition of the individual, the location and size of the electrodes between which it is measured and the dryness and general condition of the skin beneath the electrode contacts; for a young adult in normal condition it may be between 350 and 3,000 ohms. The word ohm is derived from the name of a German physicist, Dr. G. S. Ohm, who in 1826 for the first time explained the relation between electromotive-force, current and resistance.

B. The number of rotations of the house meter multiplied by its constant should equal the number of rotations of the master meter multiplied by its constant. Thus, if X is the number of turns of the house meter corresponding to forty turns on the master meter, then

$$40 \times \frac{2}{3} = X \times \frac{5}{4}, \text{ or } X = 21\tfrac{1}{3}.$$

The Westinghouse portable standard or master integrating meter has its series coil placed in series with the house meter and its pressure coil in parallel with that of the latter meter. The test is usually made at two loads, a light-load test at about four per cent of normal load and a full-load test. In each case the number of revolutions of the master-meter disk made in the same time as, say, twenty-five revolutions by the house-meter disk are carefully noted. The two products referred to above should be equal; if that of house meter is less than that of the master meter, then the house meter is slow; if its product is greater, then it is running fast. The percentage of error is readily calculated by considering the master meter's product as 100 per cent. The house meter has its retarding-disk magnets adjusted to give as near perfect accuracy as possible.

C. The following general formula is used for the calculation of the size of copper wire:

$$\text{Circular mils} = \frac{D \times I \times K}{p \times E}$$

in which D = length of the wire (one way) in feet,
I = current (load) in amperes,
E = volts between wires at receiving end,
p = percentage voltage drop in line,
K = the constant 2,160 for direct-current circuits.

CHANGE OF FAN-MOTOR FREQUENCY.—Please tell me what is necessary to change an alternating-current fan motor of the induction type from 133 to sixty cycles. —M. S. W., Linton, Ind.

A reduction of frequency reduces the impedance of the motor so that it would take an excessive current at the lower frequency. To keep the current to a safe value, it is necessary to rewind the coils with more turns of smaller wire, or, if rewinding is not desired, to place a resistance or reactance coil in series with the machine in order to cut down the voltage. It may be cheaper and certainly will be more satisfactory to dispose of the 125-cycle motor and to buy a sixty-cycle machine.

MAKERS OF THE CHORALCELO.—Kindly give us the name and address of the makers of the Choralcelo, referred to in your issue of May 8.—P. C. M., Philadelphia, Pa.

This new electric musical instrument has aroused considerable interest and a number of inquiries similar to the above. It is made by the Choralcelo Manufacturing Company, whose address is: In care of Wilbur E. Farrington, 33 Broad Street, Boston, Mass.

Melbourne Railways Not to be Electrified.

Disappointment is felt by British electrical manufacturers as to the decision of the Victorian Railway Commission not to proceed with electrification of the Melbourne (Australia) suburban steam railways. C. H. Merz, who was responsible for electrification of the first steam railway in Great Britain, had reported in favor of gradually electrifying some 129 miles at a cost of $11,135,000. He reported that with the increased traffic to accrue, the scheme would be financially sound, but the commission does not agree with his estimates, and holds that for several years equally good or better financial results can be obtained by overhauling steam rolling stock and running an accelerated service.

The Southwestern Electrical and Gas Association—Fifth Annual Convention.

The fifth annual convention of the Southwestern Electrical and Gas Association was held at the Southland Hotel, Dallas, Texas, on May 20, 21, and 22. President R. B. Stichter called the convention to order in the grand dining room of the Southland at 10:40 a. m. on Thursday morning, May 20, before a record attendance. A most cordial address of welcome was made by Harry L. Seay, Fire and Police Commissioner of Dallas, in the absence of Mayor Hay, who was out of the city. Commissioner Seay spoke in his happiest and most humorous style, as did also Sam A. Hobson, of St. Louis, who made the response. After some new members had been elected by acclamation, President Stichter proceeded to deliver his annual address, an abstract of which follows:

PRESIDENT'S ADDRESS.

"The state has just passed through the unique experience of a regular and two special sessions of our state legislature, and yet I am pleased to say that we find little that can be called detrimental to the progress and development of the industries represented here. I believe this condition is largely brought about through the education of the masses that it is not our intention or desire to realize profits from improper channels, or to favor the few most able to carry the burdens. I may safely say that the degree of success attained by you gentlemen here is attested by the degree of thoroughness in which you have enforced your policies of treating all your customers and patrons alike.

"I believe that the success of the industries we represent will be greatly enhanced through the organization of a committee on uniform city laws.

"A committee composed of members of the executive committee can do much good through the organization of a publicity department, obtaining through the secretary, or otherwise, information relating to the success or failure of the policies of our industries, and in many cases the industries themselves. You, as business men, would not undertake what you knew to have been tried by others and failed, unless you were satisfied your local conditions were different, and the same rule should apply to the operation of competitive companies where a natural monopoly, under proper restrictions, should exist. This applies equally to private and municipal ownerships.

"At the El Paso convention a year ago many of you recall the discussions brought about through the suggestion of the standardization of the high "T" rail. I have often, during the past year, thought of the necessity of the standardization, not so much of the high "T" rail, because I was not interested particularly in that at that time, but the standardization of almost everything connected with the practical operation of our industries. We need a standard rail, we need a standard system of accounting, and if you will stop to consider the saving in investment to be made in the standardization of many of our supplies, it seems to me strange that we, in the interest of good, should have been banded together for six years without the organization of a department to assist in establishing standards that will assist in preventing the loss of life and capital, and make our supplies more uniform and interchangeable. I want to recommend the appointment of a standing committee which shall act under the direction of the executive committee on standardization."

W. B. HEAD, PRESIDENT THE SOUTHWESTERN ELECTRICAL AND GAS ASSOCIATION.

The following gentlemen were appointed a committee to report on the recommendations in the president's address: H. S. Cooper, of Galveston, L. L. Stephenson, of Big Springs, and J. Balis Earl, of Waco.

PRODUCER PLANTS FOR SMALL CENTRAL STATIONS.

After some general business, a paper was presented by W. B. Head, of the Stephenville Light and Water Company, Stephenville, Texas, on "Producer Gas Plants for Small Central Stations," in which he discussed the subject from the operator's rather than from the engineer's standpoint. The producer plant, Mr. Head said, will give satisfactory service and materially reduce the fuel consumption, a very necessary desideratum toward reducing operating expenses in order to enter successfully into competition with gasoline and other new and improved lighting systems now on the market. The producer plant, in fact, was the only hope for many small central stations.

The small steam plant is at best an extravagant affair, and most of those in use are extremely inefficient. Probably at least seventy-five per cent of the small steam plants in Texas are operating under conditions which require from ten to fifteen pounds of coal per brake horsepower per hour. Several builders of producer plants are guaranteeing a fuel consumption of from two to three pounds of lignite per brake horsepower-hour on a fifty per cent load factor. Considering the cheapness of Texas lignite and its almost unlimited supply, the use of this fuel for producer plants should do much for Texas from an industrial standpoint, notwithstanding the higher cost of installation of the producer plant and the better class of labor needed to operate it as compared with the steam plant.

THURSDAY AFTERNOON SESSION.

At the afternoon session H. S. Cooper, of the Galveston City Railway Company, read an interesting paper on the "Scope of Legal and Claim Departments and Their Relation to Each Other," and W. C. Forbess, of the Northern Texas Traction Company, a paper entitled "Organization and Operation of a Claim Department." Some general business and a Question Box discussion concluded the session.

FRIDAY MORNING SESSION.

The Friday morning session was divided into two parts; the electrical men continued their meeting in the main dining room of the Southland Hotel, while the gas men convened in the private dining room of the hotel.

At the electrical meeting the following papers were read and discussed: "Lamps for Residence Illumination; Their Characteristics and Comparative Economy of Operation," by Prof. Arthur Curtis Scott; and "Low-Pressure Turbines," by Fred M. Lege, Jr. Abstracts of these papers will be given in future issues of the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN.

At the gas meeting the following papers were presented: "High-Pressure Gas Distribution for Commercial Purposes,"

by H. M. Moore; "A Method of Determining the Total Sulphur in Gas," by L. B. Morehouse; "Preparation of Purifying Material, and the Purification of Gas," by Clark F. Farmer.

FRIDAY AFTERNOON SESSION.

At the Friday afternoon session the important and progressive policies, suggested by President R. B. Stichter in his annual address, were adopted by the convention. These are in short: Appointment of a committee to draft uniform city laws, ordinances governing the operation of public-service corporations; the establishment of a publicity department; the appointment of two standardization committees; the fixing of a permanent office of the association, and the election or appointment of a permanent official to have charge of the office.

For association expenses $2,000 for the ensuing year was requested.

The rest of the session was occupied with a Question Box discussion, and a special supply men's session was also held.

On Friday evening the Sons of Jove assembled at the Southland Hotel and marched in procession to Turner Hall, where a "rejuvenation" was held and thirty-five new candidates initiated.

SATURDAY MORNING SESSION.

The Saturday morning session opened promptly at 10 a. m. with a paper by Thomas C. Cook, of the Waxahachie Electric and Gas Company, Waxahachie, Texas, on "Economies That Can Be Made in the Operation of a Small Central Station," following which was a lively discussion of the Question Box, Prof. A. C. Scott presiding. General business, reports of the secretary, committees, and treasurer, and the election of officers, etc., concluded the session. An executive session was afterward held.

In the secretary's report the fact was mentioned that 339 delegates had registered at this convention, as against 140 for the previous year and 157 for 1907. This should be very gratifying to the members of the association.

The following officers were elected: President, W. B. Head, Stephenville; first vice-president, W. B. Tuttle, San Antonio; second vice-president, J. E. Carroll, Beaumont; third-vice-president, C. H. Dunbar, Houston; treasurer, A. E. Judge, Tyler; secretary, E. T. Moore, Dallas.

The Executive Committee consists of: W. B. Head, Stephenville; W. B. Tuttle, San Antonio; J. E. Carroll, Beaumont; C. H. Dunbar, Houston; A. E. Judge, Tyler; R. B. Stichter, Dallas; J. C. Storm, Amarillo; L. L. Stephenson, Big Springs; J. W. Carpenter, Corsicana.

An advisory committee and a finance committee were also elected. The Executive Committee will decide on the next convention city and will make its report later.

A generous scheme of entertainment was provided for the members and visitors, including automobile rides for the ladies, several luncheons, a theatre party and visits to public-utility plants and points of interest in the city and vicinity.

A report of this convention would be incomplete without a special mention of the splendid souvenir programme, which was distributed to those present. This contained a history of the association, halftones of the officers, a roster of the officers, members, etc., programme of the meetings and entertainments, an illustrated guide to Dallas, "The Business Center of the Great Southwest," and last, but not least, the Question Box of over 250 questions and answers on electrical, gas and traction matters. The fifty-four advertisements, occupying 24 pages, netted the association a sum of $1,290.

Illinois Leads in Electric Lighting.

During the last six months 195 new electric-lighting companies have been formed in the United States and twenty in Canada and Mexico. The present total for the United States is 5,264 companies and 5,740, including Canada, Mexico and the West Indies. These figures show a total gain of 276 plants for the corresponding figures of a year ago.

Of the total 5,740 plants included no fewer than 3,193 carry electrical supplies. As many as 4,154 of the plants have alternating current, while apparently 1,669 are direct. Of the plants enumerated, 125 report themselves as pure transmission, while 594 others are either lighting and transmission, or else include railway work as well.

Illinois has still the largest number of plants—398—though outside of Chicago few of them are of considerable magnitude. New York has 358 and Pennsylvania, 346, the last state gaining fourteen in the six months. Ohio has 289, Michigan 253, and Texas the large number of 228, surpassing Indiana with 218 and Iowa with 207. Oklahoma has already seventy-six, and New Mexico fifteen. The largest gain in the half-year is in New York, with seventeen, which compares with the fourteen in Pennsylvania. As a matter of fact, the gains are distributed all over the country.

The National Irrigation Congress.

The National Irrigation Congress will hold its seventeenth session in Spokane, Wash., August 9 to 14, inclusive. It is estimated that between 4,000 and 5,000 delegates will be in attendance from this country and abroad. President Taft and several of his cabinet ministers may also be present.

Chief executives of twenty-five states and territories are to be present on Governors' Day, August 13, when Governor Hay of Washington will preside at a joint meeting of the governors and congressional representatives of the Western States to discuss ways and means of obtaining national and state legislation to encourage the development of the country as a whole and to conserve its natural resources.

The national officers of the 1909 congress are: President, George E. Barstow, Barstow, Texas; first vice-president, H. D. Loveland, San Francisco; second vice-president, R. E. Twitchell, Las Vegas, N. M.; third vice-president, I. D. O'Donnell, Billings, Mont.; secretary, B. A. Fowler, Phœnix, Ariz.; assistant secretary, F. H. Griswold, Chicago; foreign secretary, Rev. Dr. E. McQueen Gray, Carlsbad, N. M.

Central Station to Supply Power for Southern Pacific Suburban Lines.

In regard to the power to be furnished the Southern Pacific's suburban service in San Francisco by the Great Western Power Company, H. St. Sinclair, vice-president of the Edison Electric Company, who took entire charge of the Great Western Power Company of San Francisco on June 1, states that his company has closed a contract with the Southern Pacific Railroad to furnish power for the operation of all the suburban lines of that company in and around San Francisco, such as the broad gauge and its Alameda lines.

Mr. Sinclair says $2,000,000 will be expended by the power company in the next two years, in addition to the $8,000,000 already invested, and that the ultimate improvements planned will represent an outlay of an additional $20,000,000.

"This company is building for the future," he said, "and within ten years it will be equipped to supply 500,000 horsepower, where it is now supplying 60,000 horsepower. A dam to cost $800,000 will be started on the Feather River next fall. Plans are also being prepared for one of the largest artificial reservoirs in the world."

Annual Convention of the American Institute of Electrical Engineers.

The twenty-sixth annual convention of the American Institute of Electrical Engineers will be held at the Hotel Frontenac, Frontenac, Thousand Islands, N. Y., from June 28 to July 1, 1909.

The Institute headquarters during the convention will be at the Hotel Frontenac. On arriving at the hotel each member should register at the headquarters and obtain an identification badge. The convention sessions will be held in the hotel.

The following programme, subject to changes, has been arranged.

MONDAY, JUNE 28.

Morning Session, 10 a. m.—Louis A. Ferguson, president's address. A. E. Kennelly, C. A. Wright and J. S. Van Bylevelt, "The Convection of Heat from Small Copper Wires;" E. F. W. Alexanderson, "Alternator for 100,000 Cycles;" L. W. Chubb, "Method of Testing Transformer Core Losses Giving Sine-Wave Results on Commercial Circuits;" M. G. Lloyd and J. V. S. Fisher, "Testing of Transformer Steel."

Afternoon Session, 2 p. m.—F. Creedy, "A Sketch of the Theory of the Adjustable-Speed, Single-Phase Shunt Induction Motor;" E. F. W. Alexanderson, "Repulsion Motor with Variable-Speed Shunt Characteristics;" A. Miller Gray, "The Heating of Induction Motors;" S. V. Charters, Jr., and W. A. Hillebrand, "Reduction in Capacity of Polyphase Motors Due to Unbalancing in Voltage;" A. S. Langsdorf, "The Current Locus of the Single-Phase Induction Motor."

TUESDAY, JUNE 29.

Morning Session, 10 a. m.—P. H. Thomas, "Output and Regulation in Long-Distance Lines;" P. H. Thomas, "Calculation of the High-Tension Line;" J. B. Taylor, "Even Harmonics in Alternating-Current Circuits;" J. B. Whitehead, "The Resistance and Reactance of Armored Cables."

Evening, 6 p. m.—Dinner and discussion by the sections committee and section delegates.

Evening Session, 8 p. m.—W. S. Moody and G. Faccioli, "Corona Phenomena in Air and Oil and Their Relation to Transformer Design;" E. E. F. Creighton and S. D. Sprong, "Surges on Cable Systems with Aluminum Cell Protection;" J. L. Woodbridge, "Split-Pole Converters and Storage-Battery Regulation."

Parallel Session, Tuesday, 8 p. m.—H. C. Specht, "Function of Flywheels in Connection with Electrically Operated Rolling Mills;" K. A. Pauly, "Alternating-Current Motors versus Direct-Current Motors in Steel Mills;" E. W. Yearsley, "Rolling-Mill Motors;" E. Friedlander, "Electrically-Driven Rolling Mills;" B. Wiley, "Power Requirements for Rolling High-Carbon Steel of Small Section;" C. T. Henderson, "Electrical Control for Rolling-Mill Motors."

WEDNESDAY, JUNE 30.

Morning Session, 10 a. m.—L. W. Downes, "Some Considerations in Designing Heavy-Capacity Fuses;" C. J. Fechheimer, "Comparative Costs of Twenty-five-Cycle and Sixty-Cycle Alternators;" I. E. Hanssen, "Calculation of Iron Losses in Dynamo-Electric Machinery;" J. N. Dodd, "Auxiliary Poles for Direct-Current Machines;" L. T. Robinson, "Electric Measuring Devices;" C. A. Adams, "Electromotive-Force Wave-Shape in Alternators."

THURSDAY, JULY 1.

Morning Session, 10 a. m.—F. B. Jewett, "The Modern Telephone Cable;" C. A. Adams (title of paper not yet announced); C. R. Dooley, "The Education of the Electrical Engineer;" C. P. Steinmetz, "The Value of the Classics in Engineering Education."

ENTERTAINMENT.

The convention committee announces the following social functions:

No entertainment has been planned for Monday afternoon, but boating, fishing, golf, croquet and other outdoor pastimes will be available.

On Monday evening there will be a reception and dance at the Hotel Frontenac.

On Tuesday afternoon there will be a qualifying round in a handicap golf tournament. The first eight will qualify for the semi-finals. There will also be a women's putting contest.

Tuesday evening there will be a women's bridge tournament.

Wednesday morning there will be a daylight steamer excursion for women through the Thousand Islands. The semi-finals of the golf match and a driving contest will be held Wednesday afternoon.

Wednesday evening there will be a searchlight trip of fifty miles among the islands on a large boat for both men and women.

The finals of the golf tournament will take place Thursday afternoon.

Prizes will be given for the various competitions and tournaments, as well as for the largest fish caught during the convention, and also for the largest "catch."

It is proposed to have available a number of launches which can take small parties around through the islands, these parties to be made up by the individuals wishing to take advantage of them. Application may be made to any member of the convention committee. Golf will be available for men and women at any time, as the golf links are adjacent to the hotel and are readily accessible. There is a fine nine-hole course. Individuals can obtain guides and rowboats at a minimum charge for fishing at any time. The fishing is excellent.

TRANSPORTATION.

It has been deemed inexpedient to make application for reduced rates on the certificate plan as heretofore, chiefly on account of the fact that the railroad companies which still use this plan have this year raised the rates. Practically all the transportation companies will have special summer excursion rates to the Thousand Islands in force at the time of the Institute convention. These rates are in general the most advantageous that can be obtained, and in most cases are very little, if any, in excess of the rates that might be obtained under the certificate plan. Members should consult their local ticket agents regarding routes and rates, preferably several days before they intend to start for the convention.

HOTEL RATES.

Every member should arrange for his own hotel accommodations. Early application is desirable. Correspondence on this subject should be addressed to the Hotel Frontenac, Frontenac, N. Y. The management of the hotel has made the following rates, on the American plan, for members and guests attending the convention: Four dollars per day per person for room without bath; $5 per day with bath. The rate per day per person is the same whether one or two persons occupy a room.

The 1909 convention committee consists of: C. W. Stone, chairman, Schenectady, N. Y.; A. W. Berresford, Milwaukee, Wis.; W. A. Bucke, Toronto, Canada; Sidney Hosmer, Boston, Mass.; John W. Lieb, Jr., New York city; J. C. McQuiston, Pittsburg, Pa.; D. F. Schick, Philadelphia, Pa.; A. M. Schoen, Atlanta, Ga.; S. D. Sprong, New York; Earl Wheeler, Washington, D. C.; J. C. Wray, Chicago, Ill.; L. S. Streng, Louisville, Ky.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

THE LEPEL SYSTEM OF WIRELESS TELEGRAPHY.

One of the deficiencies of most of the present systems of radiotelegraphy is that the spark gap which is shunted with a condenser circuit has to be made comparatively large for the energy of oscillations produced, in order that the disruptive discharge across the gap shall not be followed by arcing. The Lepel system of wireless telegraphy permits the use of a large supply of energy with a very small gap. In one arrangement of the Lepel transmitter, a continuing source of electric energy is supplied through resistances to two electrodes which are separated by thin disks of paper with a hole punched through the center. The electrodes are also connected to two oscillatory circuits of different capacities, but having the same natural frequency. The radiating circuit is coupled inductively to one of these circuits. It is found that a rapid succession of sparks takes place across the gap, gradually burning away the paper, oscillatory currents at the same time surging in the condenser circuits. The action would appear to be as follows: The condensers are charged till the sparking potential is reached; a spark passes, and a small portion of the oscillatory energy probably follows the spark, but as the oscillation constants of the two circuits are the same, and very slightly damped, the discharge tends to take place in the complete circuit with both condensers and both inductances in series. As this discharge hardly flows through the gap, the source of supply continues to charge the condensers instead of arcing across the electrodes. If sparking only took place at one point, the local heating would make the air between the electrodes conducting, and an arc would be formed. The action of the paper is apparently to keep the sparking points continually on the move. The latest arrangement of transmitter is shown in Fig. 1, in which it is apparent that the aerial circuit replaces one of the oscillatory circuits in the apparatus described above. To the extreme left are the source of electric energy and the resistances. *EE* are the electrodes separated by the annular paper disks—in practice usually two pieces of foreign note paper (very thin, tough writing paper). The aerial circuit and oscillation circuit are doubly coupled —a very loose electrostatic coupling at the electrodes and a variable electromagnetic coupling between the inductances *CD*. It is said that however fast this last coupling is made, only one principal wave is detected. The receiving circuits form a modified Stone arrangement, as shown in Fig. 2. The circuits *A* and *B* are oscillating; circuit *C* is aperiodic. The detector *D* is usually of the thermo-electric type. At the Twickenham station, which the writer (C. C. F. Monckton, M. I. E. E.) saw through the courtesy of Dr. Erskine Murray, consulting expert to the Lepel Wireless Telegraph Syndicate, the energy was taken from the local electric supply company at a pressure

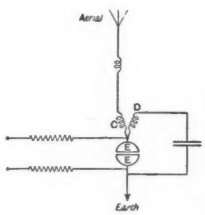


FIG. 1.—NEW TYPE TRANSMITTER.

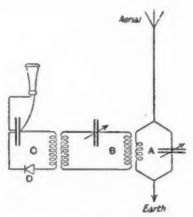


FIG. 2.—RECEIVING CIRCUITS.

of about 480 volts. A bank of incandescent lamps in series reduced the pressure across the electrodes to from 250 to 350 volts, and the current used was about four amperes. A 200-watt lamp held against the aerial was well lit, and from the reading of the hot-wire instrument in the aerial circuit it would appear that 300 watts or more were being radiated. The syndicate at present is at work perfecting an arrangement for imposing a low frequency on the high-frequency oscillations, so as to give a musical note in the receiver, and thus allow the use of a monotone telephone, which would take the place of the ticker of the Poulsen system. A large range of notes can now be transmitted from the syndicate's Slough station. The writer was impressed by the smallness and simplicity of the apparatus for connecting the direct-current supply into high-frequency oscillations, and the system should lead to considerably reduced cost for radiotelegraph apparatus. It was not apparent how syntonic the system is at present, but a very great improvement will be reached when most of the wave train can be cut out so that only that portion will be employed which will give a definite note in a monotone telephone receiver.—*Abstracted from Electrical Engineering (London), May 18.*

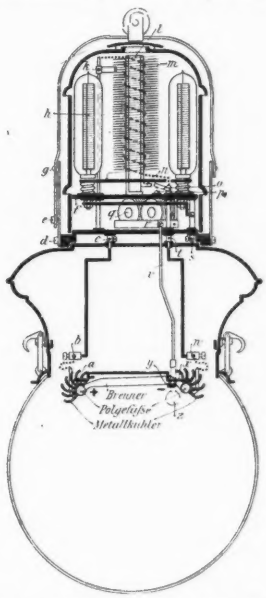
ELECTRIC DRIVE IN TEXTILE FACTORIES.

The opinion is often expressed that electric driving, especially on the individual system, absorbs more power than does the steam engine with its shafting in a mill. In admitting this to be a fact in many instances, it is asserted that in such cases the motors employed have a very low degree of efficiency. The advantage of economy in power is to be gained by the use of highly efficient motors; but the working of installations with these is more costly, which is sometimes an obstacle to its adoption. Nevertheless it is argued that advantages must be gained by using perfect motors, even if they are nullified somewhat by the additional outlay. In deciding whether it is advisable to adopt individual or group driving, much depends upon the class of machines to be driven, as well as upon the conditions of the district in which the mill is situated. With individual driving the manipulation and upkeep are simpler and cheaper than with group driving. Furthermore, with single driving, the motors can be worked in any convenient position. By connecting the motors directly to the machines, the latter, it is stated, run more evenly than when several are driven from one shaft; and as the former system is more favorable to high speeds, it would seem to be more suited to the present demands of the textile industry. In adopting electric driving, it is important to select motors of the simplest construction, and such as are easily manipulated. For this reason, only three-phase alternating-current motors can usually be employed successfully, and, where possible, they should have short-circuited rotors. Direct-current motors are no longer considered suitable, on account of their having a commutator. For the same reason, three-phase alternating-current motors with slip-rings are unsuitable in most cases. Again, ventilated enclosed motors, with the commutators and slip-rings invisible, are also less in favor, because it is difficult to discover when they are out of order. In tex-

tile mills the motors should be completely covered in, so as to be protected from dirt and dust, otherwise the ventilation will become obstructed and hence the motor unduly heated. It must be admitted, however, that these completely covered-in motors are liable to become more heated than are uncovered ones; but this disadvantage may be overcome by using motors of the highest efficiency, that is to say, with all the loads coming into operation at once. It is not sufficient that the efficiency should be high with normal load, and affected with a lighter or a heavier load. In comparing the cost of the two systems the group drive is considered less costly when only regarded from the electrical standpoint; but when everything is taken into account, the individual drive is preferable in every way.—*Abstracted from The Indian Textile Journal (Bombay, India), for April.*

DR. KUECH'S NEW FORM OF QUARTZ LAMP.

The quartz lamp is a mercury-vapor lamp of high economy (0.25 watt per Hefner candle) and long life (2,000 to 3,000 hours). It owes these advantages to the employment of quartz glass as enclosure for the mercury-vapor arc. Quartz glass has a very high melting point and withstands all temperature changes without cracking, and therefore the mercury vapor may be heated to very high temperatures. The mechanical part of the quartz lamp is very simple and serves only for starting the lamp, not for regulating the arc, and is therefore subject to no wear. The construction of the lamp, and the circuit arrangement are shown in the illustration. The burner consists of a short quartz tube, carrying at each end a cylindrical quartz vessel filled with mercury, into which the terminals are led. It is supported in its axis *a x* in two bearings; by means of the rod *v* it is connected with the armature *r* of shunt magnet *q*, and upon turning on the lamp it is tilted about its axis in such a way that the positive pole vessel is raised and the negative lowered, so that mercury flows from one pole vessel to the other and a conducting connection is established between them. The current thus arising magnetizes the choking coil *l*, which attracts its armature *o*, and thereby opens the circuit of the tilting magnet *q* at *p*. The burner then resumes its original position, the mercury parts in the tube, and an arc is formed at the breaking point. This arc will be maintained only if the burner is evacuated; if there is air in the tube the arc will be extinguished and the tilting begins anew. This will be repeated, if there is only a little air in the burner, until sufficient mercury has evaporated to maintain the arc. The high efficiency of the quartz lamp is due to the fact that the mercury vapor in it is heated extremely high; its temperature is estimated at 5,000 to 6,000 degrees centigrade. This enormous heat can be attained only by simultaneously raising the pressure of the vapor in the burner. As there is no pressure in the highly evacuated burner immediately after starting the lamp, the temperature of the arc is low in the beginning, and the tension at the terminals of the burner and its illuminating power are small. Gradually the mercury in the pole vessels is heated by the arc, the vapor pressure rises and the resistance of the arc and the tension at the burner terminals increase. The resistance in the circuit must, of course, be varied to correspond to the change of resistance in the arc. In the beginning it must be high and then gradually diminished. This change is effected by the use of iron-wire resistances (*hh*). Iron has a very high temperature coefficient and its resistance increases fourfold when it is brought to a low red heat by the current, as happens in the quartz lamp resistances. From ten amperes in the beginning the current gradually falls to 3.5 amperes on account of the change in the resistance of the arc and iron wires. The vapor pressure in the burner rises according to the increase in the tension of the arc. When the burner is in a stationary condition—that is, under a tension of 180 volts at its terminals—the vapor pressure is one degree atmosphere; consequently the walls of the burner are not subjected to any pressure from the interior or from the outside, which fact contributes greatly to its durability. At the present time one type of burner is manufactured for tensions between 100 and 130 volts, which absorbs four amperes and eighty-five volts and gives 1,200 Hefner candles. For tensions between 200 and 250 volts two types of burner are made, one for 2.5 amperes, 160 volts and 1,500 Hefner candles; the other for 3.5 amperes, 180 volts and 3,000 Hefner candles. Smaller lamps are in preparation.—*Translated and abstracted from Elektrotechnische Zeitschrift (Berlin), April 29.*



QUARTZ LAMP FOR 3.5 AMPERES, 220 VOLTS.

MORE POWER FROM THE SAME FUEL.

Used under a boiler to develop steam for a steam engine, only about eight per cent, under average conditions, of the heat energy available in a pound of coal is turned into useful energy at the engine flywheel. When this same coal is used in a producer plant to make gas for a gas engine, from fifteen to twenty per cent of its available heat energy is transformed into useful energy at the flywheel. The Norton Company, at Worcester, Mass., has installed a producer-gas-engine equipment, including a 500-brake-horsepower, four-cycle, double-acting gas engine, direct-connected to a 300-kilowatt electric generator. The producer is of the pressure type. According to figures given by George N. Jepson, assistant superintendent of the Norton Company, the initial cost of this plant, including the electric generator, producer plant, holder, piping and erection, was $84.43 per brake horsepower. Based on a working day of ten hours and 300 working days in a year, this plant costs to operate thirty dollars a brake horsepower per year, which includes the cost of coal at five dollars a ton and a depreciation charge of three per cent. These results compare very favorably with those of steam-engine plants, for which a cost of forty-five dollars a year per brake horsepower is a fair average figure.—*Abstrated from Factory, for May-June-July.*

Power in the United States.

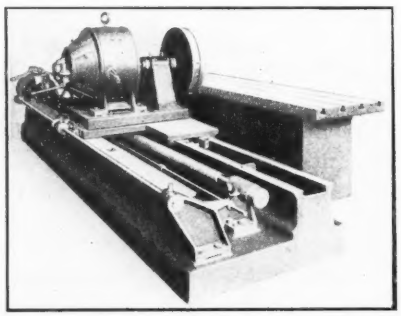
At the time of the last census there was a total of about 11,300,000 horsepower used in the operation of the factories of the United States. Of this about seventy-seven per cent was steam, fifteen waterpower, and less than two per cent gas power. In the past nine years the use of waterpower has greatly increased.

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

Motor-Driven Traveling-Head Face Grinder.

Progress in one direction of manufacturing begets progress in another. This is no better instanced than in the developments which have taken place in recent years in machine tools. The use of high-speed steel for the tools has permitted the more rapid machining of ordinary work, and hence a redesign of the tools, as well as the working of the grades of hardened steel. But the progress has gone so far in its demands for all sorts of hardened steel products that in some instances it is more satisfactory to remove the material by grinding than by machining. It is interesting to recall that but a few years ago grinders were used only for sharpening tools, and were not very satisfactory for that, while now they grind away not the tool that cuts the metal, but the actual work that is to be done.



MOTOR-DRIVEN TRAVELING-HEAD FACE GRINDER.

A very satisfactory type of traveling-head grinder, herewith illustrated, is known as a face grinder. It is particularly adapted to the work of structural iron workers, bridge builders, safe makers, and manufacturers in kindred lines, where it is necessary to grind to very exact figures any materials that are liable to be too hard to be machined, such as beams, columns, steel safe plates, cast-iron floor plates, iron staircases, cast-iron fences and railings.

As shown in the illustration, the grinding head is direct-connected to an electric motor, which, together with a very heavy outboard bearing, is mounted on a large base, moving on ways. The motor has an extended shaft to carry the grinder chuck. The work is stationary, being bolted to the large platen in front of the twenty-two-inch emery ring, while the ring rotates and also moves slowly back and forth from end to end of the platen. The reversing is done by a hand lever, when the machine is in use, but automatic stops are provided at each end of the extreme travel to prevent over-travel should the attendant neglect to reverse the feed. The maximum traverse feed of the grinder is one-half inch, and is operated by a hand-wheel and miter gear on the splined shaft in the front of the machine. The longitudinal travel of the grinder is obtained from the powerful feed screw shown in the illustration. Attention is called to the fact that the travel, twenty feet per minute, is somewhat faster than might be supposed from the thread of the screw, as a triple thread is used. The lead screw is driven by a second motor, not shown in the illustration.

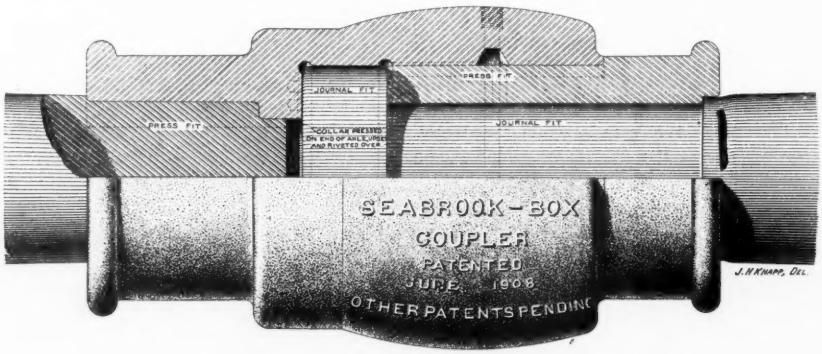
The grinder is driven by a standard Westinghouse type S compound-wound, direct-current, ten-horsepower motor, totally enclosed, and running at 1,100 revolutions per minute. Where required, an alternating-current motor may be supplied in place of the direct-current motor. The size of the motor to operate the lead screw is dependent upon the nature of the work to be performed, that is, the amount of metal to be removed.

The machine shown is a 102-inch face grinder manufactured by the Diamond Machine Company, of Providence, R. I.

A Differential Axle Coupler.

The only vehicles in use to any considerable extent in which the wheels do not operate differentially are railroad cars. The consequence is that an enormous aggregate amount of power is annually wasted on steam, electric, and other railroads, especially on overcoming friction through the slip of the inner wheels in rounding curves.

Up to the present the many devices that have been invented to give the wheels a differential movement have all failed. A new differential coupling, however, has recently been invented by B. R. Seabrook, a well-known engineer, which has emerged successful from some very exhaustive trials as to its efficiency and reliability by independent and skeptical parties.



DIFFERENTIAL AXLE COUPLER.

The device is extremely simple, as it is held together without bolts, screws or rivets, the parts being assembled by hydraulic pressure in the same way that the wheels are pressed and held on to the axle.

The action of the differential axle coupler is merely to permit one-half of the axle, with its wheel, to revolve independently of the other half. Lubrication is permanently accomplished by the forcing in of graphite under enormous pressure during assembling. The construction of the coupling is clearly shown in the illustration.

Several railroad companies are making trials of this new axle coupling, which is manufactured by the American Differential Railway Axle Company, Los Angeles, Cal.

Woods Electrics.

The Woods Motor Vehicle Company, Chicago, Ill., which specializes on the Queen Victoria type of car, shown in the accompanying illustration, puts out a fine line of these electric automobiles for city use, the salient features of which are described below.

With the exception of the Hess-Bright bearings, the Exide batteries, the tires and the raw materials, all parts of the Woods Electrics are made in their own factories.

Forty-cell batteries are used on these cars, as being the largest number that can properly be charged at the supply pressure of 110 volts, which prevails in this country. This is commendably good practice and reduces the cost of charging and upkeep to a minimum.

WOODS MOTOR VEHICLE COMPANY'S QUEEN VICTORIA ELECTRIC MODEL.

The motor frame is of Parsons manganese bronze, a metal as strong as good steel and somewhat tougher, and which can be cast readily into the somewhat intricate shape rendered necessary by the exigencies of good design for a maximum structural strength of frame.

The transmission is one of the mechanical features of the car. A pinion on the motor shaft drives a large gear wheel mounted on the differential housing which is situated on the under side of the motor frame. The power is transmitted from each end of the bevel-gear differential through a universal-joint shaft to the driving sprockets, and thence by chains to the rear axle. Smoothness of running is attained by the use of double-helical, or "herringbone," teeth on the pinion and differential gear wheel. The sprocket ends of the shaft are mounted on outboard bearings, the housings of which are supported on short transverse studs, so that they can swing in the longitudinal direction of the car. Each outboard housing is connected to the rear axle by a distance rod made of two sections joined by a turnbuckle, so that the chain tension can be adjusted without destroying the axle adjustment. This type of construction eliminates the side drag on the tires which would result if the housings were fixed, and considerably reduces the power consumption when traveling over rough roads, as proved by actual test.

The four-pole, series-type motor has been specially designed with regard to economy in the consumption of battery power, and in its mechanical and electrical construction embodies the best features of railway practice. It is impossible to overheat the motor by continuous running, as the motor is designed to run the vehicle longer than the rated capacity of the battery.

The controller is of the drum type and follows closely in its design the best features of street-railway practice.

The wiring is made very flexible to prevent breakage and is covered with a special rubber composition to prevent corrosion. Although fixed firmly to the car, the wires are readily accessible for inspection or repairs. The lights and bell operate on forty volts and are connected permanently to wires away from the battery compartment.

Four speeds are provided by changing the motor and battery connections. The maximum speed claimed is nineteen miles an hour when the top is not used, and a radius of fifty miles on a single battery charge is guaranteed, although the makers state that under ideal conditions a mileage of 100 would be nearer the mark.

Hess-Bright bearings are used throughout, and the axles of special steel are of orthodox design. The springs, both front and rear, are three-quarter elliptic platform and are made of the highest quality of oil-tempered steel. The lower half of the side spring is coupled to the cross-spring through a single-link shackle, thereby permanently fixing the relative positions of the axles. The span irons are of girder section and are made of Parsons manganese bronze.

The brakes are two foot-operated inclosed expanding brakes, one in each rear hub, and a band brake on a pulley mounted on the armature shaft. All of these have special features of design. The band brake is operated by a reverse motion of the controller handle and remains locked until released by a latch on this handle. This interlocking feature has been patented.

The side-lever steer is employed. The tires are of solid rubber. The equipment includes a complete tool and repair outfit, odometer registering trip and total mileage, combination ammeter and voltmeter, etc.

It is interesting to note that over 1,500 Woods Electrics are in continuous daily use in the city of Chicago alone. After this it is not necessary to make mention of the various record-breaking runs the Woods cars have made in the face of well-nigh insurmountable difficulties.

The Woods Motor Vehicle Company made an extensive exhibit at the National Electric Light Association's show at Atlantic City, June 1 to 4.

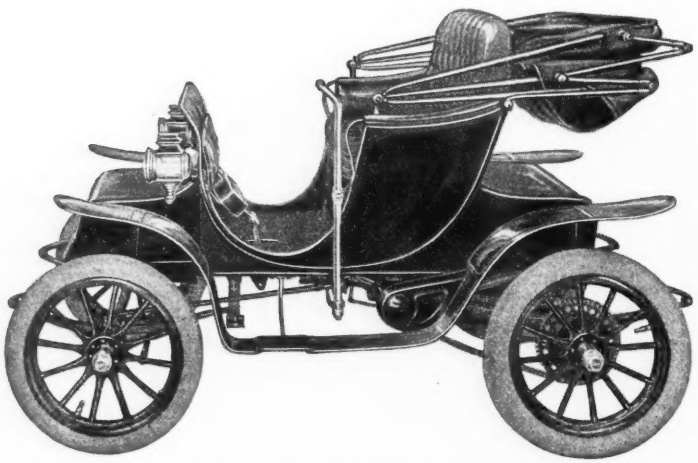
Helium for Airships.

Helium is the ideal gas for all lighter-than-air airships, said Professor Erdmann the other day in a lecture in Berlin. Had Count Zeppelin used it, he declared, the catastrophe at Echterdingen last August would never have occurred.

While its lifting power is about 1.11 kilogrammes a cubic metre, or little less than that of hydrogen (which is given at 1.20 kilogrammes), it is neutral and non-inflammable, and can stand a cold of 268.5 degrees centigrade without liquefaction. The difficulty is to get the helium. The small quantity of 400 litres possessed by the Leyden University is cherished as a treasure.

Columbus Electrics.

One of the interesting exhibits and demonstrations at the convention of the National Electric Light Association at Atlantic City, N. J., June 1 to 4, was that of the Columbus Buggy Company of Columbus, Ohio. This company exhibited its models 1000 and 1001. The accompanying illustration shows the Victoria Phaeton, Model 1001. This model is graceful, stylish and comfortable and is a most popular vehicle for general service. The frame is made of hot-riveted press steel, with full elliptic rear springs, and half-platform front springs. The wheel base is seventy-four inches and the gauge four feet two inches from center to center of wheels. The wheels are wood, of the artillery type.



COLUMBUS ELECTRIC VICTORIA PHAETON, MODEL 1001.

The motor is of the multipolar type with slotted armature, removable coils, carbon brushes, positive tension brush-holders, annular pole bearings, and the motor is set in an aluminum supporting frame provided with an improved noiseless type of transmission enclosed in an aluminum case.

The controller is of the latest improved radial type, with combined reversing switch, self-cleaning contact points and interlock. The reversing switch can be used as an emergency switch in opening the circuit, should it become necessary.

Adding to the Day Load.

The already widespread, yet ever-increasing use of electric vibratory massage machines would seem to indicate that the public mind has accepted this device as one of the utilities, and there is good reason to believe that its judgment as usual is sound.

In the old days, when conditions were different, before the telephone, the trolley car, steam-heated flat, etc., made human movement unnecessary, the exigencies of life required sufficient physical effort to keep the body in condition. Now all that is changed, and exercise is taken passively with the vibrator, maybe. Thus we keep the hair on our heads, and the roses in our cheeks with the vibrator. If this is considered an exaggeration, a tour of physicians' offices, barber shops and beauty parlors will show what is going on.

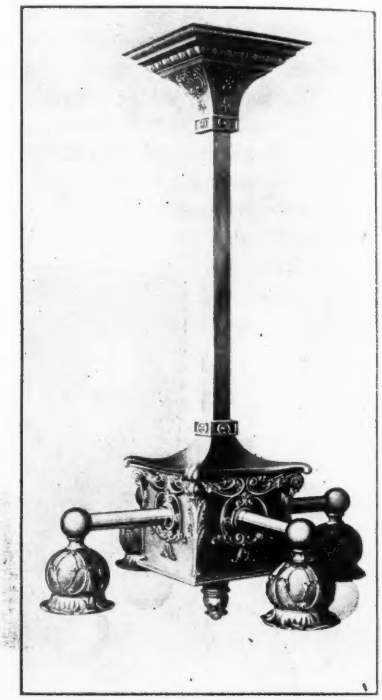
The truth is, that these machines, as now constructed, are almost perfect as regards weight, poise, and reliability of operation. The regulation of the stroke is at all times subject to the control of the operator, and can be varied from a blow strong enough to blacken the eye, to an imperceptible touch. It is, therefore, no wonder that more uniform results may be secured mechanically than by hand treatment from an indifferent but highly expensive masseur.

There have recently been placed upon the market several high-grade, but medium-priced, machines of this kind with which excellent results have been secured. One of the best of these is the "Central" Vibrator, sold by the Central Electric Company of Chicago. It embodies all the improvements of the latest designs, is of excellent workmanship throughout, and can be used interchangeably upon alternating or direct current.

There is no doubt but that this is a field for central-station effort which will yield excellent results, for the most successful machines are built to operate upon lighting circuits, and they all help to increase that day load—a most desirable feature from the manager's standpoint—especially as they tend to increase the popularity of electricity in the household.

Box-Type Renaissance Westinghouse-Nernst Chandelier.

The Nernst Lamp Company has added to the designs of Westinghouse-Nernst chandeliers the box-type Renaissance chandelier shown in the accompanying illustration. The design is massive and substantial and its middle portion is larger than the round-type Renaissance design previously brought out. This gives the fixture a more compact appearance and adds to the artistic effect when the lamps are not burning. It is made for sixty-six, eighty-eight, 110 and 132-watt lamps.



BOX-TYPE RENAISSANCE CHANDELIER, WITH WESTINGHOUSE-NERNST LAMPS.

Frink Reflectors.

The firm of I. P. Frink, 551 Pearl Street, New York city, has always stood in the forefront of the lighting business. This company is always ready to cope with any problem in illumination, and engineers or contractors who have anything special in the way of lighting find many suggestions upon consultation with this old-established house.

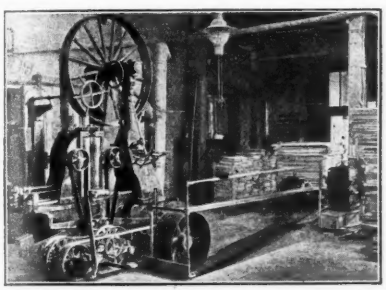
Its window reflector, which is now used successfully with twenty-five-watt tungsten lamps burned in a horizontal position, is one of the most popular adaptations. For general interior illumination the special reflectors for tungsten lamps are put forward as among the most efficient and economical lighting fixtures on the market, and are being rapidly adopted in all parts of the country.

As an example of the special work which this firm is doing may be mentioned the recent equipment of the lighting features in the banquet hall and art gallery of the Lotos Club, in New York city.

A special bronze reflector has been brought out for illuminating the desks and screens of banks. This device has been installed in the new National City Bank, New York, and also in the Importers' and Traders' National Bank of the same city.

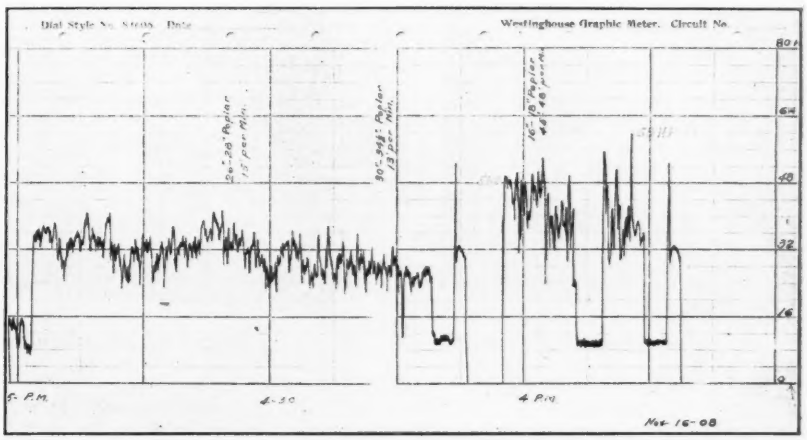
Motor-Driven Band Resaw in Carriage Works.

In the plant of the Detroit Carriage Works at Detroit, Mich., a large amount of poplar is used in the building of automobile bodies, the greater part of which must finish one-quarter inch or less in thickness and from twelve to thirty-six inches in width. The stock from which the panels are made is usually one inch thick and is therefore resawed in the factory into three boards one-quarter inch in thickness, the loss in sawing being about one-quarter inch or less, according to the gauge and set of the saw. The saving in the lumber effected by the use of band resaws over circular resaws for this class of work is too well known to require discussion, and has been responsible for the installation of band resaws in many body and carriage works. In the Detroit Carriage Works all work of this sort is done by a sixty-inch American band resaw.



MOTOR-DRIVEN BAND RESAW IN DETROIT CARRIAGE FACTORY.

The sawing of this stock into one-quarter-inch paneling is one of the first processes in the manufacture of bodies, and hence it is most economical to have the resaw located at the point where the stock is received, which would often be a long distance from the engine room in an engine-driven power system. These resaws ordinarily require from thirty to fifty-horsepower, according to the size and character of the work. The speed must be very uniform in order to obtain satisfactory operation. With a central steam plant this would require the installation of a system of line shafting and belting from the engine to the saw, capable of transmitting fifty horsepower without excessive variation in speed. In case there were also other heavy machines supplied from the same shaft, as is almost certain to be the case, the throwing on or off of any one of these would be certain to cause serious difficulties at the resaw, because the speed of the saw would fall off very materially when another machine was being started or would increase when one was thrown off. With a serious drop in the speed the saw does not cut well and causes imperfections in the work; whereas increase of speed tends to injure the blade itself from too rapid feeding and from too great a strain on the saw.



GRAPHIC RECORD OF MOTOR INPUT IN TEST OF MOTOR-DRIVEN BAND RESAW, TAKEN BY WESTINGHOUSE GRAPHIC METER.

These troubles have been overcome in this factory by the installation of a Westinghouse type CCL alternating-current induction motor of forty-horsepower capacity running at a speed of 1,120 revolutions per minute, the application being made as shown in the accompanying illustration.

A test was recently made on this outfit with a graphic recording wattmeter so connected as to read the total power supplied to the motor. A portion of the curve obtained in this test is shown herewith and affords a very convincing proof of the advantage which electric drive takes of any let-ups in the work. At the right may be seen the scale of input to the motor in kilowatts, and at two points the horsepower output of the motor has been indicated.

During this portion of the test there had been one shutdown and three periods of about five minutes each when the motor was running without load, as shown by the low points in the curve. The stretch from about 4:10 to 4:55 p. m. is interesting, for it shows how the workman was able to keep the machine loaded.

After the first sawing the two boards are put through again but reversed so that the quarter inch is taken off the other side of the board, leaving the center one-quarter inch thick, more or less, according to the kerf made by the saw. When sawing the narrower panels the feed is faster than with the wider ones because a better finish is required for the larger work.

The result is that the power required to cut the narrower stock is greater than for the wider. This is clearly indicated on the curve. In passing, attention is directed to the overloads carried by the motor, fifty-six horsepower in one case and sixty-nine in another. The former was sustained for some time while cutting the 16-inch stock. The induction motor is particularly well adapted for this work, as it will stand sudden and severe overloads without trouble and also maintains a very uniform speed.

It is to be noted that the saw is being crowded by the workman under these conditions, so that it would be difficult to increase the power requirements without sawing a harder wood, and that it is entirely satisfactory in the operation, even under these overload conditions.

Fulton Light, Heat and Power Suit.

The $3,500,000 suit of the Fulton Light, Heat and Power Company against the state of New York, which is a test for claims aggregating $10,000,000, has been called at Rochester, N. Y., before the State Court of Claims.

Starting Panels for Direct-Current Motors.

The use of starting panels for direct-current motors instead of a starting rheostat with separate switch and fuses is becoming quite popular in a large number of industries, largely because the panel insures a satisfactory location for rheostat, fuses, switch or circuit-breaker.

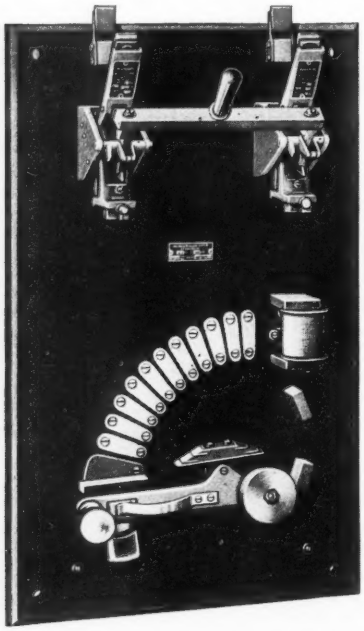


FIG. 1.—TYPE "ZB" STARTING PANEL AND CARBON-BREAK CIRCUIT-BREAKER.

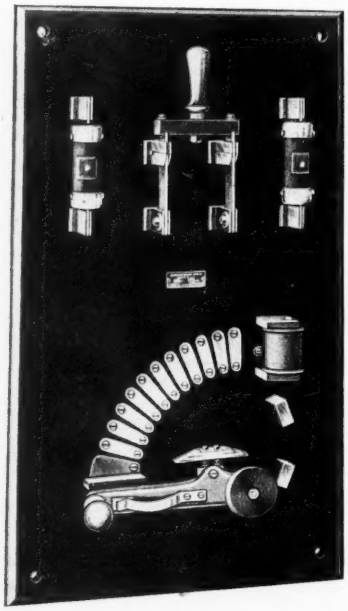


FIG. 2.—TYPE "ZA" PANEL WITH MAIN SWITCH AND FUSES.

A line of starting panels has recently been placed on the market by the Westinghouse Electrical and Manufacturing Company, ranging in capacity from a starter for a one-fourth-horsepower motor at 110 volts to one for a 120-horsepower motor at 220 volts, including panels for 500-volt circuits. These panels are made up in several different styles and can be mounted with wall brackets or on tubular supports, resting on the floor.

Each panel consists of a slate slab, on which are mounted the rheostat contacts and contact arm, the main switch and fuses or the circuit-breaker. In the smaller sizes the resistance is mounted on the back of the panel, but in the larger sizes it is mounted separately. Five terminals are provided for connection to the line wires and the motor leads, and are plainly marked so that it is difficult for a man, even if unfamiliar with starting apparatus, to make a mistake in connecting, especially as a diagram is sent with the starting panels.

Fig. 1 shows what is known as a type "ZB" starting panel, with a carbon-break circuit-breaker, and Fig. 2 shows a type "ZA" panel, which has the same arrangement of face-plate contacts, etc., but has a main switch and fuses instead of a circuit-breaker. All sizes are provided with low-voltage release devices, which automatically return the contact arms to the starting position on interruption of the power. Fig. 3 shows the diagram of connections for a "ZA" panel for a one-and-one-fourth-horsepower motor. It will be noted that the low-voltage release coil is independent of the field circuit, so that

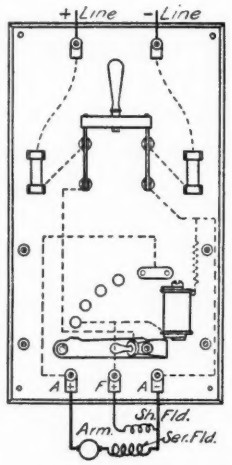


FIG. 3.—DIAGRAM OF CONNECTIONS FOR "ZA" PANEL FOR ONE-AND-ONE-QUARTER-HORSEPOWER MOTOR.

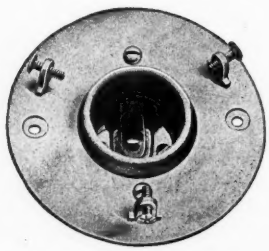
the starting panels are suitable for shunt, series or compound motors.

All contacts on sizes over one-and-one-fourth horsepower, either 110 or 220 volts, are renewable from the front without disturbing any connection. In all sizes the initial contacts are protected from burning by a quick-break arcing tip on the front of the panel or by a blow-out coil on the rear, which prevents burning the contact on opening the circuit.

New Pipe-End Fittings.

The Marshall Electric Company, Hyde Park, Mass., has recently added a large number of very important improvements to its Pipe-End line. It has been completed with devices for sockets, rosettes and switches.

One of the most popular of these new fittings is the No. 1233, which is shown



MARSHALL PIPE-END FITTING.

in the accompanying cut. This goes in the No. 1203 box (one-half-inch size) or the No. 1204 (three-fourths-inch size). The wires go straight through without cutting and are very quickly inserted and connected to the binding screws. No pulling or twisting of the wires is necessary. The receptacle also includes a two-and-one-fourth-inch shade holder.

The device is very attractive in appearance and is carried in stock by all the principal jobbers. Samples are furnished gratis to intending purchasers on application to the Marshall Electric Company, Hyde Park, Mass.

High-Tension Crossing-Protectors.

The Central Electric Company of Chicago is having considerable success in its sale of the new form of high-tension crossing-protectors, that were described and illustrated in last week's issue. In this description the General Electric Company was inadvertently given the credit of having developed this useful protective device, whereas, in fact, the Central Electric Company deserves the credit exclusively.

Tungsten Lamp Rates to be Lower.

The New York Public Service Commission has granted the application of the United Electric Light and Power Company to put into effect immediately substantial reductions in the charges for tungsten lamps.

Current Electrical News

GREAT BRITAIN.

(Special Correspondence.)

LONDON, MAY 22.—What may be regarded as the last stage of the controversy concerning the installation of the G. B. surface-contact tramway system in London rather adds to the mystery already surrounding the decision of the London County Council to abandon it. Most people are already wondering why, having called in an independent expert, the Council should have ignored his advice to continue the system. There has just been published the final report of W. M. Mordey, president of the Institution of Electrical Engineers, upon his investigations into the matter on behalf of the County Council, and in this he deals seriatim with the objections of the Council's own officers. So far as the wording of this report goes it refutes in toto every objection made, and presumably this attitude could be substantiated. In fact, Mr. Mordey states that he has not been given an opportunity of demonstrating to the highways committee the facts upon which his conclusions are based. Except from the point of view of a possible legal action, the report can do little good now, as the trackwork on the G. B. system is being withdrawn preparatory to installing a combination of conduit and overhead systems.

Apropos of this matter, Mr. Mordey read a most interesting paper before the Institution of Electrical Engineers last night, in which he described the effect of his experiments upon condensers in their application to the extinction of arcs at the studs. By placing a condenser across the arc he showed by a model that it was possible to extinguish it every time.

An electrical system for controlling heavy guns on board ship, the invention of Rear-Admiral Sir Percy Scott, is now being given a trial in the British Navy. Practically every operation in the working of the gun is carried out electrically from a control station. A large number of trials have been made and the experiments are being continued.

A donation of $250,000 has been made toward the equipment of a general engineering laboratory in connection with the Imperial College of Science.

Although much faith was placed in the utility of the subway footway for connecting the various adjoining underground stations of different lines on the London tube railways, experience has shown that, owing to the distances separating these stations, in many cases considerable time, and consequently traffic, is being lost. In order to overcome this gradually growing prejudice on the part of the traveling public trials are to be made with a moving platform running in these subways.

An instance of the strides made in the application of electricity to mechanical engineering in coal working is afforded in the development of the Denaby Main Colliery, South Yorkshire. An electric winding plant is to be installed designed to lift 140 tons per hour, with two double-deck cages, carrying eight corves of coal. The motor is designed for a peak load of 700 horsepower and a mean of 340 horsepower, at a speed of 392 revolutions per minute. The supply is at 3,000 volts, forty periods. A special feature of the plant will be the brake gear, which is operated by compressed air from an electrically driven air compressor. A large number of safety devices are also being provided to prevent accidents, such, for instance, as the automatic tripping of the emergency brake in the event of a failure of current, and a similar operation of the brake in the event of the attendant forgetting to switch off and thus allowing the cage to approach the surface at too great a speed.

As an outcome of the experiments during the past few years of Sir Oliver Lodge and those associated with him, upon the application of electricity to the growing of crops, a company has now been formed under the title of the Agricultural Electric Discharge Company, to deal more adequately with the question. G.

CONTINENTAL EUROPE.

(Special Correspondence.)

PARIS, MAY 22.—The Swedish government has just put in practice a new telephone tariff which gives subscribers even lower rates than the previous one. Installing the post in the first place costs $3; the yearly subscription, which allows for 600 communications, figures for $9, and there is an extra rate of one-and-one-half cents for each communication above that figure.

In Holland there is a project on foot for an electric tramway between the communes of Arnhem and Renkum-Osterbeek. The town of Amerongen is taking measures to erect an electric-light and power plant.

The Italian Carbide Company has recently erected two large hydroelectric plants in the neighborhood of Terni, which have a combined capacity of 30,000 horsepower at the present time. The first plant, located at Collestalle, is installed for manufacturing carbide, as well as cyanamide, while the second plant, at Pepigno, produces carbide exclusively. At present the two factories have an output of 24,000 tons annually, but it is expected to increase this to 50,000 tons in the near future by making use of an additional hydraulic supply.

Work is soon to begin upon an increase in the city traction lines of Fiume, Austro-Hungary. One of the lines will be run through the suburbs and will reach the locality of Kantrida, on the Istrian frontier. It is expected to complete this section of line within six months. The town of Sümeg is making arrangements to install an electric-light and city water pumping plant. At Szolnok the municipality is taking measures to build an electric-tramway line.

Negotiations are being made to apply the electric system upon the rack incline from Budapest to Schwabenberg, as I already mentioned, and the municipality wished the Budapest Tramways Company to take it over and to supply the current for operating it. The company is now willing to take charge of the matter and will either furnish the current after making the transfer to the electric system or else will operate the line entirely after a certain date. The rates for the supply of current have already been fixed.

In the new Molmar electric plant at Madrid there is used a method for cooling the transformers which differs from the usual practice. The plant requires current over a 150-mile power line, which is operated at 66,000 volts, and there is installed a bank of eight transformers of the oil type. The oil is taken out of the tank by piping and goes through a worm placed in a cold water tank, returning thence to the transformer. This method is applied by the Siemens-Schuckert Company, and it is an advantage where the supply of cooling water is limited. A. DE C.

WESTERN CANADA.

(Special Correspondence.)

WINNIPEG, MAY 29.—The civic board of control at Winnipeg has decided to at once call for tenders for electrical equipment in connection with the power development at Point du Bois. Advertisements regarding the quantity and particulars of the machinery desired will be issued immediately. The estimated cost of the equipment required is $500,000. Inquiries should be sent to Cecil B. Smith, civic expert, Winnipeg, Man.

The Thunder Creek Rural Telephone Company has been incorporated, at Carievale, Sask., to build rural telephone lines in that district. Construction will be started at once.

Sir Edward Clouston, Montreal, Que., has been elected a director of the Kaministiquia Power Company, whose field of operations is near Fort William, New Ontario.

Work on the Brenda municipal telephone system is again in progress. The head office of the mnnicipality is at Napinka, Man.

The provincial government of Alberta has decided to install an automatic telephone system in Lethbridge, tenders for which will shortly be requested. The province is also considering the installation of automatic systems in all cities, towns and villages in the province.

Sealed tenders will be received by T. Fargey, Govan, Sask., until noon, June 15, for the supply of all materials and the construction of sixty miles of pole line for the Govan Rural Telephone Company.

Officials of the Manitoba Government Telephone Commission state the reduction in rates recently announced has proved most popular with the public. During April 311 new instruments were installed in Winnipeg alone, against forty-eight for the same month in 1908. Orders are coming in very fast from all over the province, and it is expected May will prove a record month for new connections.

W. L. Harris, Winnipeg, Man., is now at Nelson, B. C., where, with the assistance of the board of trade of that city, he will build a number of telephone lines to the surrounding fruit ranches. He expects to commence active construction within two or three weeks. R.

IMPORTANT DEVELOPMENTS.

(Special Correspondence.)

CONNECTICUT RIVER POWER COMPANY INCREASES CAPITAL—At a special meeting of the stockholders of the Connecticut River Power Company, of Maine, the corporation which holds the stock of the Connecticut River Power Company, of New Hampshire, owning the dam at Vernon, the charter was amended so as to increase the capital of the company from $2,500,000 to $3,220,000. General Manager Henry I. Harriman, of

the Connecticut River Company, says that the plant at Vernon will be in operation July 1. The towns to which the power will be transmitted will be Brattleboro, Vt.; Keene, Hinsdale and Winchester, N. H.; Gardner, Leominster, Fitchburg, Clinton, Shirley, Marlboro and Worcester, Mass.

HELENA AND BUTTE ELECTRIC RAILWAY—J. G. White & Company have underwritten the $2,500,000 bond issue of the Helena & Butte Electric Railway Company. The line will be seventy-five miles long. Work is to be started at once.

NIAGARA FALLS POWER COMPANY VOTE ON MORTGAGE—Shareholders of the Niagara Falls Power Company voted favorably June 1 on the proposition of authorizing a $25,000,000 mortgage to secure bonds maturing in 1932, and to bear interest at not exceeding six per cent. The proceeds of the issue are to be used to refund some $9,000,000 debentures, and for other corporate purposes, chief among which is some new construction on the Canadian side, to cost in the neighborhood of $4,000,000.

MERGER OF DENVER (COLO.) STREET-RAILWAY AND POWER COMPANIES—The long-predicted reorganization of the Denver City Tramway Company, the Denver & Northwestern Railway Company (the holding company of the Tramway) and the Tramway Power Company, will be authorized in detail at the annual stockholders' meeting of the Denver & Northwestern Railway Company, which has been called for early in June. The plans of the reorganization, as outlined at present, are for the Tramway Company to take over all Northwestern stock, holdings and assets, and to pay for this property with Tramway stock issued at a ratio of about three for one. David H. Moffat and William G. Evans own a majority of Northwestern stock. The new stock will be issued at about 80, while Northwestern today is quoted at 150, so that present holders of Northwestern stock will receive Tramway stock worth approximately 130 for the 150 taken over. Immediately after the directors' meeting of the Northwestern Railway Company the Tramway Company will start work on the handsome and modern seven-story office building.

CHATTANOOGA UTILITIES DEAL—Some weeks ago a joint resolution was presented to both boards of the Chattanooga (Tenn.) City Council authorizing the consolidation of the Chattanooga Electric Railways Company and the Chattanooga Electric Company. Through a deal just closed in Louisville, Ky., it is now known that both companies have passed into new hands. Two brokerage firms, E. W. Clark & Company, of Philadelphia, and Hoodenpyl, Walbridge & Company, of New York, have secured possession of controlling interests in the two companies, acting for the General Electric Company, of New York. This great corporation now owns the majority shares of the two public service corporations. The capital stock of the Chattanooga Railways Company is $1,000,000 five per cent preferred and $2,000,000 common stock. The electric company is capitalized at $500,000 preferred and $1,000,000 common stock. The latter company is chartered under the laws of Maine. The stock of the new corporation will be $2,000,000 preferred and $3,000,000 common. By the terms of the deal just completed in Louisville a controlling interest in the Chattanooga Railways Company passes to E. W. Clark & Company at twenty-five dollars a share for the common. Holders of preferred stock of the old companies will receive equal amounts of preferred stock in the new company.

LIGHTING AND POWER.

(Special Correspondence.)

CAMBRIDGE, NEB.—The plant of the electric-light company has been burned. Loss about $20,000.

GREENVILLE, TEX.—This city will vote on a bond issue for the improvement of the electric-light system.

KENTON, OHIO—The Kenton Gas and Electric Company has plans for changing its system from 125 cycles to sixty cycles, at a cost of $20,000. Extensive improvements will be made, so as to dispense not only light but power. H.

LINTON, IND.—The Linton electric-light plant is to be sold to a Chicago company for $25,000. The majority of the Councilmen are in favor of the sale, and a special meeting probably will be called soon to complete the transfer.

TERRE HAUTE, IND.—The Vandalia Railroad Company has decided to build a large engine shop and enlarge its terminal at this point. The shops will be equipped with the latest electrical apparatus for power and lighting. Over $500,000 will be expended in the work. S.

FULTON, N. Y.—The granting of a franchise to the Niagara-Oswego Power Company to operate in this city continues to cause much agitation pro and con. The Fulton Light, Heat and Power Company declares that as soon as its litigation with the state is ended it will spend from $500,000 to $750,000 for the purchase of waterpowers and the installation of a large water-steam electric plant. The company continues to publish arguments why it should be preferred to the Ontario company. It urges that among other things the power is made in Canada and is subject to the artificial restrictions and tariffs placed upon its use by the governments of Canada and the United States and the province of Ontario. It also declares that a steam reserve is the only reserve that can be depended upon.

TACOMA, WASH.—City officials have been in camp inspecting the site of Tacoma's proposed $2,000,000 power plant on the Nisqually River. The surveys for the dam, the flume and the power house site have been completed and condemnation proceedings have been instituted by the city attorney.

JERSEY CITY, N. J.—Over $107,000 has already been subscribed for stock in the proposed new Citizens' Light, Heat and Power Company. At a recent meeting, at which over $5,000 of stock was subscribed for in a few minutes, a resolution calling upon the Common Council to grant the franchise asked by the Citizens' Company was unanimously passed.

THE CALIFORNIA GAS AND ELECTRIC CORPORATION, controlled by the Drum, Tevis, Martin and De Sabla interests, and operated in conjunction with the San Francisco Gas and Electric and the Pacific Gas and Electric companies, is the largest corporation of its kind in California, and has long dominated the situation in the bay and central coast counties.

MALONE, N. Y.—The up-State Public Service Commission has consented to the sale by Sidney S. Whittelsey of his electric-light plant in this village to the Malone Light and Power Company. It was found that the two plants could not be operated successfully in a village of the size of Malone, and the sale, which has been approved by the Commission, was the result.

INDIANAPOLIS, IND.—Bids will soon be asked by the trustees of the Indiana School for girls for the installation of a lighting plant at the institution near Clearmont. Likewise, the Commission empowered to build the Tuberculosis Hospital near Rockville will receive bids for the installation of a power and lighting plant. Bids will be received at room 25, State House, Indianapolis, Ind. S.

GRIDLEY, CAL.—A matter that is about to occupy public attention here is that of the purchase of the lighting plant and franchises constituting the estate of the late Robert F. Beebee, by the city. It is given out that as soon as the courts can adjust the matter of probating the estate the plant and property will be offered for sale, and it is the general impression that the city will buy it.

LAWRENCE, KAN.—A. E. Mosier, of the Allis-Chalmers Company of Detroit, has been in Lawrence making the final plans for the installation of the new power plant here to furnish the electricity for the street-car system. According to the plans the power plant is to be double in size until it can furnish daily 2,500 horsepower. The present lighting system and the mills take 1,200 horsepower.

NINETY-NINE ISLANDS, S. C.—The new plant of the Southern Power Company being built here is showing rapid progress, and several hundred men are at work on the dam. The company is now supplying about 80 per cent of its enormous electric-current output to cotton mills, about 400 of which will ultimately come within the zone in North and South Carolina supplied by the above-named company. L.

BOSTON, MASS.—The Edison Electric Illuminating Company, of Brockton, a Stone & Webster property, has petitioned the gas commission for approval of issue of $160,000 additional stock, to retire part of floating debt, and for acquisition of the Stoughton Gas and Electric Company. It also asks approval of purchase of the Bridgewater Electric Company. It already holds a controlling interest in both companies.

CLINTON, MO.—Articles of incorporation have been filed here with the County Recorder preparatory to sending in to the Secretary of State, for a new corporation, which is being formed in this city with a capital of $50,000, $25,000 of which is paid up and which will be operated under the name of the Western Utilities Company. Object, to operate steam, water or electric power or electric-light plants, gas plants and water plants.

LINCOLNTON, GA.—The dam and power plant of the Twin City Power Company, on the Savannah River, four miles from Lincolnton and thirty miles from Augusta, Ga., is now well under way of construction. The plant, transmission lines, etc., will, it is declared, represent an outlay of $5,000,000. The power will be utilized for the operation of car lines and cotton mills and factories, in Georgia and the lower part of South Carolina. L.

ROCKINGHAM, N. C.—In the Circuit Court of Appeals, sitting at Richmond, Va., Judge J. C. Pritchard has entered a decree in the case of the S. Morgan Smith Company against the Rockingham Power Company and the Knickerbocker Trust Company (New York) ordering the sale of the property of the Rockingham Power Company in a lengthy and interesting litigation begun some time ago. This sale is to take place on July 14 at Wadesboro, N. C., the sale being for the purpose of winding up the affairs of the power company, commissioners appointed to make the sale being named in the persons of W. H. Browne and W. A. Leland, receivers of the power company. The court also

authorized the receivers to issue certificates of indebtedness, which will take precedence as a lien on the power company property in preference to and in priority to any other indebtedness or lien now existing against said property. Provision was also made for securing funds to protect the property until the date of the sale in July. L.

ABERDEEN, S. D.—Plans are being formulated for the installation of an electric-light and power plant at the Normal College. Prof. L. E. Akeley, dean of the engineering department at the state university, was here last week in consultation with President Nash. Professor Akeley has just installed a similar plant at the university. The local institution needs to supply 800 lights and operate machinery in the industrial and domestic departments.

CALHOUN, KY.—Walter J. Kern, of the Kern Electrical Company, of Owensboro, Ky., has the franchise and contract with the city for lighting streets, etc., with 100-watt tungsten lamps. A seventy-five-kilowatt plant is about completed, and will be ready for operation about June 10. It is contemplated to light all the towns and villages adjacent to Calhoun in the county of McLean, making it a county lighting plant for both towns and rural farming districts.

RUSHVILLE, IND.—The City Council will award a contract in a few days for the installation of a new engine and electric unit in the city water and light plant. The bidders are: Arbuckle & Ryan, New York; Ridgway Dynamo and Engine Company, Pittsburg; Western Electric Company, Chicago; Allis-Chalmers Company, Milwaukee; Annis Iron Works, Oswego, N. Y.; Lane and Bently Company, Cincinnati; Jones and Clark, Louisville, and Hoover-Owen-Rentchler, of Hamilton, Ohio. S.

EUGENE, ORE.—The Oregon Conservation Commission is drawing attention to the tremendous waterpower available in the Deschutes River. The Secretary of the Commission declares that there is concentrated in the available power of the Deschutes the greatest quantity of energy capable of practical development to be found in the United States. There is, he says, a million and a half horsepower capable of development. This amount of power could easily be secured in the lower 140 miles of the river.

ST. LOUIS, MO.—The consideration for the purchase of the Laclede Gas Light Company, which has recently been acquired by the American Light and Traction Company of New York, is said to be approximately $7,500,000, of which $1,500,000 is to be paid in cash, and the balance in securities of the American Light and Traction Company. These consist of $2,500,000 in debenture bonds, $2,500,000 in preferred stock, which is quoted at $106, and 5,000 shares of common stock, quoted at $192.

ASHEVILLE, N. C.—The North Carolina Power Company, a subsidiary of the Weaver Power Company, announces that as soon as an agreement with the Southern Railway Company can be reached, it will begin work on a power plant on the French Broad River, which will cost about $450,000, and when completed will furnish a continuous current equal to about 10,000 horsepower. It is estimated that two years will be required to complete the work, employing a force of 150 men continuously.

COLUMBUS, OHIO—The trustees of the Girls' Industrial School, Rathbone, Ohio, have commissioned H. M. Bush, consulting engineer, Broad-Oak Building, Columbus, Ohio, to draw up plans and specifications for the installation of additional boilers, generators and engines, and electrical equipment, for lighting and power purposes at the school. Equipment will probably comprise two 75-kilowatt, direct-current generators and engines, as well as switchboard and wiring. The school has no electrical equipment at present. B.

SALT LAKE CITY, UTAH—Negotiations are in progress for the installing of a big electric-light and power plant on Deep Creek, in the Seven Devils district. Thirty thousand horsepower can be harnessed. The stream carries over 2,500 inches of water and falls 4,000 feet in six miles. A prominent Pittsburg company is in correspondence with the owners of the water right to put in the machinery for the big system. It is planned to make stations on the stream from its head to where it empties into Snake River.

JOLIET, ILL.—The Economy Light and Power Company, of this city, has about perfected its plans for making the streets in the business district attractive at night with ornamental light and trolley poles combined. Moreover, the innovation will absolutely get rid of all unsightly poles and wires. The poles to be used will be very ornamental. Each will consist of a steel pole twenty-eight feet high, in three sections of seven, six and five inches diameter, encased in an ornamental cast-iron outer pole. The center of each cluster of lights will be twelve-and-one-half feet from the sidewalk. Clusters of four sixty-watt tungsten arc lights to each pole are to be used. Already frontage contracts for two years at $1.25 a front foot per year have been very generally obtained. The cost is low at the start, but even so after the expiration of the two years it will be materially reduced, as the expense of installing the plant will have been paid, leaving only the cost of the electric current to be made up to the company, with the cost of maintenance.

LITTLE ROCK, ARK.—The most extensive development of the waterpower possibilities of the state ever made is to be the result of the incorporation of the Pike County Water Company. The headquarters of the company will be located at Murfreesboro, in Pike County. A capital stock of $1,000,000, with $600,000 subscribed, is back of the enterprise. The purpose of the company is explained, in part, to be that of "building, constructing and maintaining dams for the storage of water and to purchase and operate electrical machinery," by means of which the waterpower is to be developed.

SAN FRANCISCO, CAL.—John C. Rice, of Boston, has purchased the properties of the Tuolumne Water Power Company and the Stanislaus Electric Power Company, at $2,200,000. Mr. Rice represented the United Railroads Investment Company, of new Jersey, a holding company of the United Railroads of San Francisco. A new company is to be organized, the stock of which will be controlled by the United Railroads Investment Company. It is stated that bonds will be issued and sold to enable the company to complete its work of construction, which now extends only as far as Mission San Jose.

CONDON, ORE.—The Wasco County Electric and Water Power Company held the annual meeting of its stockholders at Condon, Ore., on May 13, when the following men were elected members of the board of directors for the ensuing year: George S. Carpenter, F. T. Hurlburt, C. W. Lord, Homer I. Keeney, H. J. Martin, Mark W. Gill, C. S. Greaves, C. D. Charles, George Ainslie, Herman C. Smith, H. W. Nottingham, W. H. Hurlburt, G. L. MacGibbon, O. C. Hughson and O. B. Hathaway. The trust deed for the $15,000,000 bond issue, as approved by the Carnegie Trust Company, of New York city, was also read and ratified.

TEXAS CITY, TEX.—The Texas City Company, which has awarded the contract for about $2,000,000 worth of port improvements here, including the construction of a system of seven warehouses, will equip the latter with electric freight conveyors which will be the longest of their kind in the United States. Under the new system a steamer's cargo may be assembled a mile from the pier, loaded onto the conveyor and placed at the ship's side in a few hours. The cargo may be started toward its destination before the steamer has been berthed, so that as soon as the vessel is in place it can begin taking on cargo. The carriers will be built to run in either direction, so that the unloading may be carried on as expeditiously as the loading.

SAN FRANCISCO, CAL.—Definite arrangements have been made for the purchase of the City Electric Company by the California Gas and Electric Company, for $5,000,000. The $5,000,000 bonds issued by the latter company have been taken up by the National City Bank, and the First National Bank, of New York, and Lee, Higginson & Company, of Boston. The original plans of the City Electric Company for enlarging its lighting capacity will be carried out by the new owners. The plant consists of two 4,000-horsepower turbo-generators. The original plans called for an additional generator of 10,000 horsepower. The purchase will give the California Gas and Electric Company a total of 138,000 horsepower.

ELECTRIC RAILWAYS.

(Special Correspondence.)

HAZLETON, IOWA—It is proposed to build an interurban line to Oelwein, Iowa. C.

CHICAGO, ILL.—Judge Grosscup has authorized $550,000 receivers' certificates for the Consolidated Traction rehabilitation.

PHELPS, N. Y.—Work on the construction of the proposed Geneva, Phelps and Newark electric road, will begin within the next thirty days.

MINNEAPOLIS, MINN.—The Electric Short Line Railroad Company has commenced condemnation proceedings for its right-of-way to Medicine Lake, Minn. C.

WASHINGTON, N. C.—Work on the new street railway here has been started. It is under the direction of the Traction Engineering Company of New York.

MACOMB, ILL.—The line to Monmouth will be completed this summer, and there are plans on foot to secure an extension of the Rock Island Southern to this city.

PINE BLUFF, ARK.—President E. J. Seymour, of the Little Rock Transit Company, announces that a line will be built from Pine Bluff to Wilmer and probably on to Crossett.

SPRINGFIELD, OHIO—Work on the construction of a line from Springfield to Jamestown and Clifton is about to be started by the Springfield & Washington Traction Company.

EASTON, PA.—The Easton Transit Company has established an express and light freight line between Easton, Nazareth, Butztown, Bethlehem, South Bethlehem and Freemansburg.

NEW YORK CITY, N. Y.—Judge Ward, in the United States Circuit Court, has handed down an order giving to the Bank of America permission to intervene as a party plaintiff in the suit of the London Underground Electric Railway against Louis

S. Owsley, executor of the estate of Charles T. Yerkes. It was in this suit that a receiver was appointed for the Yerkes estate. The bank is a creditor for more than $128,000.

INDIANAPOLIS, IND.—The twelve electric railroads having terminals in this city have agreed upon a plan and schedule for handling and exchanging baggage. The service will begin July 1. S.

KENOSHA, WIS.—Early in June the Kenosha Electric Railway Company will commence the erection of a power plant for furnishing power for the various industries of the company in the city. C.

SACRAMENTO, CAL.—The Vallejo & Northern Railway Company has accepted a franchise for an electric railway in this city. The company has asked for an extension of time in its franchise at Vacaville, Cal.

CENTERVILLE, S. D.—The South Dakota Interurban Railway Company has been incorporated with a capital of $1,000,000 to build 160 miles of electric railway from Sioux City, Ia., to Bijou Hills, S. D. C.

PORT CHESTER, N. Y.—Final steps to foreclose a mortage for $300,000, held by the Knickerbocker Company as trustee, against the Tarrytown, White Plains and Mamaroneck Railway Company have been taken.

HOUGHTON, MICH.—A franchise has been asked for the South Range street railway. The line is proposed to extend from Hurontown to South Range with a monorail system such as is now in operation in Connecticut.

PALO ALTO, CAL.—The Palo Alto electric line is to be extended south to Monta Vista and then on to San Jose through Cupertino with connections to the foothill resorts, such as Congress Springs, Saratoga and Los Gatos.

WILMINGTON, DEL.—The Metropolitan Steam and Electric Railway Company has been incorporated with a capital of $100,000. The incorporators are: J. G. Marmion, M. Kaufman, Yorktown, Tex., and E. L. Squire, Wilmington.

MIDDLETOWN, CAL.—The Santa Rosa & Clear Lake Railway Company announces that work will begin on the construction of the road within the next ninety days. At least five miles of the road are to be completed before fall.

WATERTOWN, S. D.—A company with a capital of $50,000 has been organized to build an electric line to Lake Kampeska. The contract for the construction has been let to a Chicago firm and the road is to be ready for service by July 1. C.

FAIRFIELD, CAL.—Randall, Wright & Trowbridge, representing the new Vallejo, Benecia & White Sulphur Springs electric line, have been granted a franchise. Construction will begin within four months and must be completed within two years.

SACRAMENTO, CAL.—F. A. Warner, coast representative for the Smith Sierra-Sacramento Railroad Company, has gone East to arrange for the shipment of rails, wire, cars and other necessary material for the new electric road to Lake Tahoe.

MINNEAPOLIS, MINN.—M. W. Savage, president, has concluded a deal which will give the Minneapolis, St. Paul, Rochester & Dubuque Electric Traction Company $4,000,000 with which to complete the road from Minneapolis to Rochester, a distance of 109 miles. C.

WALLACE, IDAHO—The Spokane, Wallace & Interstate Railway Company is planning to begin soon on the construction of its eighty-four-mile electric line from Wallace, Idaho, to Spokane, Wash. Seventy-pound steel rails will be used over the entire road.

ALLENTOWN, PA.—The Perkiomen Traction Company has begun operations on a new trolley line through the Perkiomen Valley. Tracks are being laid in Collegeville and at other points along the line. The road starts at this place, and runs through Gratersford and Schwenksville to Green Lane.

SACRAMENTO, CAL.—The Sacramento Electric, Gas and Railway Company is at work building on its fifty-year right-of-way, recently secured by John A. Briton, to the State Fair grounds. This route is identical with that sought by George W. Peltier, of the California Traction Company.

GRANDVIEW, WASH.—All the material to be used in the construction of the Northwestern Light and Water Company's electric line through this place has been distributed and work started. There will be only one substation between Prosser and North Yakima and that will be at Sunnyside.

MEMPHIS, TENN.—The Rogers, Pea Ridge & Northern Interurban Company has been granted a charter under the laws of Arkansas. The capital stock is $50,000. The company proposes the construction of an electric line connecting Rogers with Elkhorn Tavern, on the old Pea Ridge battlefield, with stations at Pea Ridge and the pumping station at Bentonville. The incorporators intend building the line through the most scenic as well as the historic portion of the state, and making summer resorts of the different places along the line. The officers are A. P. Potter, president; W. T. Patterson and J. E. Walker, vice-presidents; Bryan Snyder, secretary, and J. J. Pitman, treasurer.

OAKLAND, CAL.—President Heron, of the San Francisco, Oakland & San Jose Railway Company, announces that plans are now being prepared for the extension of the corporation's tracks through upper East Oakland and Northern Fruitvale. The plans include the operation of Key Route trains to Dimond.

NEW YORK CITY, N. Y.—A protective committee has been formed to look after the interests of holders of bonds of the Lacombe Electric Company, of Denver, Colo. Holders of bonds are requested to send their address or confer with J. L. Tilton, secretary of the committee, 32 Broadway, New York.

INDIANAPOLIS, IND.—A contract for the completion of the Indianapolis, Newcastle and Toledo Electric Railway between Indianapolis and Newcastle—a distance of thirty-nine miles—has been awarded to the American Pipe and Construction Company for $446,500. The line is to be completed in six months. S.

ALBANY, N. Y.—The Upper Broadway Railway Company, of New York, has been incorporated with a capital of $750,000. The company proposes to operate a double-track street surface railroad in Manhattan three-and-a-half miles long from Twelfth Avenue along Manhattan Street to Broadway, to St. Nicholas Avenue, to Fort George Avenue. The directors are: Morgan D. Wilson, Arnold F. Wainwright and Charles F. Heddin, of New York.

WHEELING, W. VA.—The Wheeling Traction Company directors at a recent meeting decided upon big improvements. About 1,500 shares of treasury stock was ordered sold, and from the revenue eight new cars of the type used on the Panhandle division will be secured, to be used on the Rayland division. The line will be extended through Rayland and a new feed cable will be purchased and strung from the power house to Martins Ferry.

FT. WAYNE, IND.—Frank Hardy, superintendent of transportation for the Ft. Wayne & Wabash Valley Traction Company, has completed details and a time-card for a ten-train limited service between this city and Indianapolis. Five of the cars will run by the way of Peru and five by way of Bluffton, at which points they take the Indiana Union Traction Company's tracks. The distance is about 140 miles each way and the time is four hours and thirty minutes. S.

AUGUSTA, ME.—A bill in equity asking for the restoration to the stockholders of the control, management and operation of the propery of the Waterville and Fairfield Railway and Light Company, and for the appointment of a receiver to take immediate charge of the affairs of that company, has been filed in the Supreme Court. A hearing was ordered to be held at Augusta July 6. It is alleged that interest amounting to $75,000 on bonds has not been paid.

MILWAUKEE, WIS.—By unanimous agreement of the joint committees on railways and streets and alleys, a franchise on Thirty-fifth Street, from State to Burleigh streets, has been recommended to the Milwaukee Electric Railway Company. The aldermen were assured the double track line would be in operation before the end of this summer. The section from State to Clybourn streets will be operated as a single track, the west side of the street being in the town of Wauwatosa. Next year the line will be extended south of Clybourn to the edge of the bluff, near the West Milwaukee shops.

OAKLAND, CAL.—Work on the electrification of the Southern Pacific's tracks on the Alameda mole and in Webster Street is being rushed. A street railway in connection is also planned on Franklin Street. The company will then be able to carry out its plans for the construction of a loop from Sixteenth Street station to the Alameda ferry landing and cover territory now exclusively controlled by the Key Route and the Oakland Traction Company. These cars for the new lines will be much wider than those of the Key Route and furnished with roomier and more comfortable seats for passengers. Each car will have a capacity to carry eighty passengers.

KENOSHA, WIS.—By a decision handed down by the Supreme Court of Wisconsin on Tuesday, Patrick F. Haynes and Gustav L. Clausen of Chicago, who promoted an electric railway franchise ordinance in Kenosha, will get their money. The court practically directs the sale of the Kenosha Electric Railway, if necessary, to pay the claims of the two promoters. The case has been in the courts for more than seven years. Haynes and Clausen declared the Kenosha Street Railway Company had agreed to give them bonds in the amount of $30,000 for their services. After the original franchise ordinance was declared invalid by the Wisconsin Supreme Court, a new company was organized known as the Kenosha Electric Railway Company. This company refused to pay the bonds, and Haynes and Clausen brought suit.

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

ARANSAS PASS, TEX.—J. P. Gandy has been granted a telephone franchise.

ALPINE, TEX.—J. E. Mills has purchased the plant of the Alpine Telephone Company.

DIMMITT, TEX.—T. H. Beach and others are about to install a telephone exchange here.

MARMADUKE, ARK.—The Independent Rural Telephone Company will install an exchange here.

MAQUOKETA, IOWA—The Bell Telephone Company will expend $25,000 to $30,000 rebuilding its system.

HURON, S. D.—The Huron Municipal Telephone Company has been incorporated with a capital of $50,000.

WASHINGTON, LA.—The Washington Telephone Company has begun the construction of an exchange building.

NETTLETON, ARK.—The St. Louis and Southwestern Telephone Company will install an exchange at Nettleton.

GIBSONVILLE, N. C.—The secretary of state has chartered the Gibsonville Telephone Company; capital stock, $5,000. L.

FAYETTEVILLE, ARK.—The Oxford Telephone Hanger Company has been incorporated with a capital stock of $500,000.

CRYSTAL CITY, TEX.—The Crystal City Telephone Company has been incorporated with a capital stock of $10,000.

CULBERTSON, MONT.—The Montana Star Telephone Company will shortly begin the erection of a new exchange building.

DEWITT, VA.—The Dinwiddie Telephone Company has amended its charter by increasing its capital stock from $15,000 to $25,000. L.

GOODRICH, N. D.—The Goodrich Northwestern Telephone Company has been granted a franchise to build a telephone line to Lincoln.

THIEF RIVER FALLS, MINN.—A vote is to be taken July 12 on the question of establishing a municipal telephone exchange here.

OKLAHOMA CITY, OKLA.—The Crutcho Telephone Company has been incorporated by E. A. Wagner, L. M. Warner and G. B. Alguire.

JENKINSBURG, GA.—The Jenkinsburg Telephone Company has been incorporated, with $200,000 capital stock, by B. F. Aiken, J. F. Tingle and others.

JENNINGS, FLA.—The Southern Bell Telephone and Telegraph Company's main office, at Atlanta, Ga., contemplates establishment of telephone system at Jennings.

BARDSTOWN, ARK.—The Bardstown Telephone Company has been incorporated; J. M. Ward, president and treasurer; L. L. Ward, vice-president; H. S. Portis, secretary.

HICKORY GROVE, ILL.—The Hickory Grove Telephone Company has been incorporated, capital $150,000. Incorporators: H. M. Eckert, M. Muser, F. Huth, W. Muser, Lenzburg.

FRANKFORT, KY.—The East Tennessee Telephone Company, of Nashville, has withdrawn from the Department of Secretary of State its proposal to increase its capital stock from $1,000,000 to $5,000,000.

JACKSON, MISS.—The Mississippi Home Telephone Company has been incorporated, with $250,000 capital stock, by C. M. Williamson, N. D. Smith, both of Jackson; J. O. Spots, Meridian, Miss., and others.

MEADOW VIEW, VA.—The Rural Telephone Company has been chartered to build and operate a telephone line, those interested being W. H. Geisler, president; J. W. M. Whitten, treasurer, Abingdon, Va.; capital stock, $5,000. L.

HICKORY GROVE TOWNSHIP, ILL.—The Hickory Grove Telephone Company has been incorporated to operate a telephone line with a capital of $150,000. The incorporators are H. M. Eckert, M. Muser, F. Huth and W. Muser, Lenzburg.

TRENTON, N. J.—The Telegraphatype Company, of Glen Ridge, has been incorporated, capital $50,000. Incorporators: William M. Beard, Walter P. Baret and Mary V. Motan. The company is to maintain telegraph and telephone lines, etc.

LEXINGTON, TENN.—The Home Company has been organized in this county to give complete telephone connection with exchanges at Sardis, Saltillo, Henderson, Scott's Hill, Decaturville and Lexington. The central office will be located here.

NELSON, VA.—The Aarons Creek Telephone Company, with $5,000 capital, has been granted a franchise by the state to conduct a telephone exchange, with D. T. Nelson, of Virginia, Va., president, and T. B. Nelson, Nelson, Va., secretary and treasurer. L.

NASHVILLE, TENN.—The Alabama and Tennessee Telephone and Telegraph Company is reported to be about to take over independent telephone lines in Tennessee and Alabama, including the main line from Birmingham, Ala., to some point in Kentucky.

LITTLE ROCK, ARK.—The Oxford Telephone Company, of Fayetteville, was organized recently with a capital stock of $500,000. The officers are: C. E. Oxford, president; H. H. Lipman, of St. Louis, vice-president; W. N. Yates, Jr., secretary; W. H. Morton, treasurer.

CHARLESTON, W. VA.—The Marlinton & Stony Creek Mutual Telephone Company has been incorporated to construct and maintain a telephone line between Marlinton and Laurel Creek. The incorporators are: P. L. Carter, T. S. Dulany and thirteen others, of Onoto, W. Va.

BOSTON, MASS.—The subsidiary companies of the American Telephone Company report for the three months to March 31 gross earnings $32,167,100, an increase of $1,888,700, net earnings $8,566,400, an increase of $365,900, and balance for dividends $6,767,900, an increase of $541,000. These figures include the depreciation charges.

ATHENS, GA.—The Southern Bell Telephone Company has just completed an estimate on improvements to be made in this city amounting to over $12,000, the work to be commenced at once. Additional cables will be strung throughout the business district of the city and extended into the residence streets, where the poles are crowded with cross-arms and wires.

SALISBURY CENTER, N. Y.—The new telephone system at this point is being rapidly completed. The system will connect Salisbury Corners, Stratford and Emmonsburg, Dolgeville, Fairview Farm, the Salisbury Steel & Iron Works, thereby making through connections to Lake Piseco and all points over the Bell system, with a central station at Salisbury Center.

COLUMBUS, OHIO—The Columbus Citizens' Telephone Company expects to erect perhaps three substations in Columbus in the near future. A small station has been in operation on the east side for the past year, but the business of the company is increasing so that they are compelled to erect substations on the North Side and perhaps on the South and West sides of the city.

PITTSBURG, PA.—Fresh interest has been aroused in independent telephone projects during the present week by the visit of Max Koehler of St. Louis, Mo., to Pittsburg, to confer with the officials of the Pittsburg & Allegheny Telephone Company, regarding the co-operation between the local independent corporation and the new long-distance corporation backed by St. Louis and western capital, which aims to compete with the American Telegraph and Telephone Company. The western syndicate, it is stated, expects to expend $20,000,000 in the construction of its connecting lines, and will reach from Boston, Mass., on the Atlantic Coast, to Kansas City and Joplin, Mo., and branching out in various directions fill in the spaces between established independent companies that have no long-distance service now. This new company, it is said, is intended to be the great national toll line of the independent companies of the United States.

CHICAGO, ILL.—President Sunny says the Chicago Telephone Company operates in eight counties in Illinois and two counties of Indiana, and connects with twelve independent systems, refusing connection with only one. In all that territory there are 65,717 telephones outside Chicago, and 54,293 of them have connection with Chicago. In Illinois, Indiana and Ohio, 431,106 of the total of 888,898 telephones have no connections with the Bell companies. The new building to be erected by the Chicago Telephone Company will be the largest telephone exchange the company has in the city. It is to be built on the land which the company just purchased at 78 to 84 Federal Street, to cost, including site and building, $500,000. Foundations will be put in immediately for a building of from sixteen to eighteen stories, but it is the intention to construct only eight or ten stories at the present time. It is the expectation that the building will be finished within a year and a half. The building will provide accommodations for the Harrison and two other exchanges, the names of which have not yet been determined. There will be 50,000 telephones in the new exchange dependent upon the character of the lines which the company is called upon to serve upon that section of the city, and there will be 700 operators.

ELECTRICAL SECURITIES.

The business of the stock exchange for some time has been almost entirely in the hands of professional traders and that class of speculators which is quick to take profits either on the long or short side of stocks. Traders of this kind dislike to have open commitments over a three-day holiday and the prospect of such a recess after the close of business at the end of last week served both to reduce the volume of transactions in every session last week and to impart lethargy to prices.

Generally speaking prices are steady in the confidence in the

future of industrials. In particular instances shares of electric public service corporations have been exceptionally strong both in Chicago and New York.

The money markets at home and abroad do not show much change. Funds are still in plentiful supply. That the cost of money will rise in the next few months is taken for granted.

The New York bank statement last Saturday showed an increase of $5,065,450 in the excess reserve. Deposits are high and the surplus reserve as a whole is satisfactory both from the viewpoint of banking interests and the general business community. The Hill and Harriman differences have been adjusted and a future of strength is assured by the solid basis of the present.

Dividends have been declared upon the following electrical securities: Massachusetts Electric Companies; a semiannual dividend of one-and-one-half per cent on the $20,557,400 preferred stock, placing it on a three per cent basis, as compared with two per cent previously, payable July 1 to stock of record June 2. A quarterly dividend of $1.50 per share has been declared on the preferred capital stock of Blackstone Valley Gas and Electric Company, payable June 1 to stock of record May 26. Mackay Companies; the regular quarterly dividends of one per cent on the common and preferred stocks, payable July 1 to stock of record June 12. Books do not close.

ELECTRICAL SECURITIES FOR THE WEEK ENDED MAY 29.

New York:	*Closing.*
Allis-Chalmers common	16
Allis-Chalmers preferred	51⅞
American Tel. & Tel. Company	140⅜
Brooklyn Rapid Transit	79⅜
General Electric	160¾
Interborough-Metropolitan common	16¼
Interborough-Metropolitan preferred	45¾
Kings County Electric	121
Mackay Companies (Postal Telegraph and Cables) common	79
Mackay Companies (Postal Telegraph and Cables) preferred	73½
Manhattan Elevated	146
Metropolitan Street Railway	29
New York & New Jersey Telephone	122
Western Union	75
Westinghouse Manufacturing Company	82½

Gross sales of Westinghouse Electric are running at the rate of slightly better than $25,000,000 per annum, which is an improvement of about 110 per cent from the low point of the panic.

Boston:	*Closing.*
Edison Electric Illuminating	—
Massachusetts Electric	69
New England Telephone	132½
Western Telephone and Telegraph pref.	87

Application has been made to the Philadelphia Stock Exchange to list $232,587,600 capital stock of the American Telephone and Telegraph Company. This is one of the largest listings in one application in the history of the exchange.

R. L. Day & Company sold at public auction on May 26 the 1,501 unsubscribed shares of the 66,500 shares of Boston Elevated stock authorized by the railroad commission, in December, 1908. The entire lot was taken by F. H. Prince & Company, at 130¾.

Philadelphia:	*Closing.*
Electric Company of America	12½
Electric Storage Battery common	48
Electric Storage Battery preferred	48
Philadelphia Electric	11⅞
Philadelphia Rapid Transit	32⅞
United Gas Improvement	87½

There has been added to the regular list on the Philadelphia Stock Exchange $1,250,000 additional Philadelphia Transit Company five per cent collateral trust gold bonds, maturing February 1, 1957.

Chicago:	*Closing.*
Chicago Telephone	132½
Commonwealth Edison	119½
Metropolitan Elevated preferred	51
National Carbon common	86
National Carbon preferred	119

EDUCATIONAL NOTES.

RENSSELAER POLYTECHNIC INSTITUTE—The Board of Trustees of the Rensselaer Polytechnic Institute announce the opening of the Russell Sage Laboratory on Tuesday, June 15, 1909, at 12 o'clock, at Troy, N. Y. The commencement exercises on June 15 will open at 10:30 with the alumni meeting. At noon addresses will be made by Robert W. De Forest of New York and Jesse M. Smith, president of the American Society of Mechanical Engineers, and Lewis B. Stillwell, president of the American Institute of Electrical Engineers. The remainder of the day will be given over to a baseball match between the Institute and the Massachusetts Institute of Technology. In the evening there will be class reunions and dinners, and at 9:30 p. m. the commencement hop at Harmony Hall. On Wednesday at 11 a. m. there will be an address by Onward Bates, president of the American Society of Civil Engineers.

NEW TECHNICAL COLLEGE FOR INDIANA—Benjamin Brisco, president of the Maxwell-Brisco Motor Company, which has a large factory in Newcastle, Ind., is planning to erect a large building and establish a modern technical college where young men will be taught to be experts in electric and mechanical engineering. Mr. Brisco will expend $100,000 in a college building and equipment.

ENGINEERING SOCIETIES.

THE PITTSBURG BOOSTERS' CLUB—The Pittsburg Boosters' Club has been formed, the members being drawn from all the leading railway, electrical and supply companies of Pittsburg. Its object is to "boost" everything electrical. A dinner is held on the last Monday of each month. The officers are E. J. Kiefer, master controller; Henry Harris, auxiliary; Ludwig Hummel, recording wattmeter; C. B. Cushing, electrolyte.

ELECTRICAL ENGINEERS' SOCIETY, BOSTON "TECH"—Frank J. Sprague, the father of heavy electric traction, was the speaker at Professor Jackson's dinner to the Electrical Engineers on the evening of May 20, at the Union. Mr. Sprague spoke on "Electric Traction, Past, Present and Future." During his remarks he ventured a prophecy on a question that is now troubling the engineering world. For the average interurban road or road with fair density of traffic, the direct current at 1,200 volts on a third rail will be found to be the most efficient.

LOCAL SECTIONS AND STUDENT BRANCHES OF THE SOCIETY OF MECHANICAL ENGINEERS—Definite steps have been taken for the formation of a Boston local section of the American Society of Mechanical Engineers. The committee to formulate the plans consists of Prof. I. N. Hollis, Prof. E. T. Miller, C. T. Main, I. E. Moultrop and J. W. Libby, all of Boston, Mass. In St. Louis, Mo., at a recent meeting of mechanical engineers, it was decided to take steps for the organization of a local section. The following student branches have been admitted to affiliate membership in the society: Stevens Institute Engineering Society; Brooklyn Polytechnic Institute Section; Armour Institute of Technology Section; Leland Stanford Mechanical Engineering Society; Palo Alto Student Section; State Agricultural College of Oregon Section; Purdue University Section; University of Kansas Section; Cornell University Section.

NEW PUBLICATIONS.

INSTALLATION OF FIRE DOORS AND SHUTTERS—The National Board of Fire Underwriters has just issued a new edition of its rules and requirements for the construction and installation of fire doors and shutters, as recommended by the National Fire Protection Association. Property owners and architects are requested to refer to these specifications in their contracts with builders. There are in all fifty definite rules, and the booklet contains an appendix with ample illustrations. The general plan governing the arrangement of the rules is indicated by the classification, the different methods of construction and the material to be used.

THE ANNUAL REPORT OF THE HEBREW TECHNICAL INSTITUTE, for the year ending 1908, is replete with satisfactory information. Complete statistics anent the work being accomplished, are set forth and a long list of benefactions noted. Statistics as to the nationality of pupils and the occupation of their fathers are given. It may be noted that the Electrical Section is next to the Mechanical and Architectural Drawing Section in the number of students enrolled. The chart showing the scale of wages of shop hands at successive ages between boys who have had and boys who have not had technical school training is most interesting. It shows conclusively and in a practical way that this Institute is doing most excellent and much-needed work.

PURDUE UNIVERSITY'S ANNUAL CATALOGUE—Very complete and interesting is the 1908-1909 annual catalogue, April Bulletin, sent out from Purdue. Every form of information is given concerning the aim and scope of the education. Requirements for admission, expenses necessary, courses of study, degrees and graduate courses of instruction are all set forth. A complete register of students, graduates and undergraduates is given. The book is well printed and all facts are succinctly brought out. The present bulletin is Vol. IX, No. 4. Editions are issued in October, November, February, March and April. It may be noted that the electrical engineering course is very comprehensive, including laboratory machinery, designing, electric railway engineering and all branches of the science of telephony.

THE ARMOUR ENGINEER—Among the leading articles in the May number of *The Armour Engineer*, which is the technical publication of the students of Armour Institute of Technology, Chicago, are the following of electrical interest: "The Hydrometer

in the Operation of Storage Batteries," by L. H. Flanders; "Underground Conduit for the Distribution of Electrical Energy," by W. F. Sims; "The Carrying Capacity of Rapid Transit Systems," by Thos. A. Banning, Jr.; "Some New Buildings of the Chicago Railways Company," by E. F. Hiller. These articles, particularly the one by Mr. Banning, are of most timely interest; they are copiously illustrated and well worth careful reading. There are also articles of interest to mechanical, civil and chemical engineers. The editorial work of this new 148-page magazine has been very capably handled.

OBITUARY.

WILLIAM BOIES CLEMENTS, treasurer of the Northern Westchester Lighting Company, of Ossining, N. Y., and of the Peekskill (N. Y.) Railroad and Lighting Company, died on May 25 at his home in Ossining. He was born near Fredericton, N. B., thirty-eight years ago, and was a great-grandson of Capt. Peter Clements, of Westchester County, who, during the Revolution, formed a company of volunteers and fought on the side of the king. In 1783, Captain Clements and the survivors of his company joined the great exodus of United Empire Loyalists and landed in St. John, N. B. They proceeded up the St. John River and founded the colony of Kingsclear on its banks, where Mr. Clements was born and where his parents still live. For several years previous to his connection with the Ossining and Peekskill companies, Mr. Clements was auditor of the Westchester Lighting Company, of Mount Vernon, N. Y. He was a member of Hiawatha Lodge, F. and A. M., of Mount Vernon; Cortlandt Hook and Ladder Company, of Peekskill, and the Shattemuc Yacht and Canoe Club, of Ossining. Two years ago he married Miss Violet Marsh, stepdaughter of the late Right Rev. H. Tully Kingdon, Bishop of Fredericton. Besides his widow he leaves a daughter, who is four months old.

PERSONAL MENTION.

WILLIAM MARCONI, of wireless telegraphy fame, has been made a Doctor of Laws by the University of Liverpool, England.

HON. C. A. PARSONS, inventor of the Parsons steam turbine, has been awarded the degree of Doctor of Engineering by the University of Liverpool, England, on the occasion of the installation of Lord Derby as Chancellor.

WILLIAM BARCLAY PARSONS, director of the London Underground, who returned from Europe on May 25, sailed again on May 26 on the Mauretania, on receipt of a cablegram saying that Mrs. Parsons was ill in London. He expects to be back June 11.

WILLIAM D. WEAVER has edited the illustrated two-volume catalogue of the Wheeler gift of books, etc., to the American Institute of Electrical Engineers. This catalogue, which is probably the most complete list of electrical books ever prepared, is being distributed to the members and associates of the Institute.

HUGH J. McGOWAN, who is at the head of the McGowan syndicate of interurban and street railroads, Indianapolis, Ind., who is now in Switzerland and was expected home June 1, has written business associates that he will not return until September, and that an operation will be necessary to restore him to his former good health. S.

ANDREW CARNEGIE had conferred on him on May 26, by the Council of the Sorbonne, Paris, a medal in recognition of his founding the Curie scholarships in 1906. The entire faculty of the college was present, and the only outside guests were Madame Curie, widow of the scientist; Ambassador White, Baron D'Estournelles de Constant and M. Niet, president of the French Salon.

ETIS V. THURESSON, civil engineer and electrical expert, and one of the chief engineers of the Water Building Company, of Stockholm, Sweden, is just now visiting the principal water-power stations in the United States. Mr. Thuresson has already visited the large power plants and central stations of New York, Philadelphia, Baltimore, Washington, and also the General Electric Works at Schenectady.

H. B. LOGAN, president of Dossert & Company, of New York, who has just returned from a trip throughout the West, reports that he has concluded arrangements with Messrs. Otis and Squires, 155 New Montgomery Street, San Francisco, to act as Pacific Coast managers for Dossert & Company. Messrs. Otis and Squires will carry in stock a very complete line of Dossert solderless connectors, cable taps and terminals.

JACOB GOULD SCHURMAN, President of Cornell University and Chairman of the General Commemorative Committee of the Hudson-Fulton Celebration, will leave on June 9 for a European trip, during which he will attend the celebration of the one hundredth anniversary of Darwin's birth as the guest of St. John's College, Cambridge, England; the three hundred and fiftieth anniversary of the founding of Geneva University, in Switzerland (this is coincident with the four hundredth anniversary of the birth of Calvin), and the five hundredth anniversary of Leipzig University, in Germany.

INDUSTRIAL ITEMS.

THE NEW YORK INSULATED WIRE COMPANY, New York city, has opened up a new and larger New York stockroom at 80 Murray Street, to take care of the increased demand for its rubber-covered wire and insulated tapes.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., has issued Bulletin 113, giving particulars and illustrations of certain large drawbridges operated by electric motors used in conjunction with a "Chloride Accumulator" battery.

THE GATESVILLE ELECTRIC LIGHT COMPANY, Gatesville, Texas, has awarded contract to the Minneapolis Steel and Machinery Company for furnishing a 75-horsepower Muenzel gas engine and lignite producer, which is to be installed in the new plant they are building.

THE BAKER-VAWTER COMPANY, Chicago, Ill., has issued a catalogue of metal sectional steel filing cabinets, which comprise many new improvements. These cabinets are made like a modern steel building, with complete frame of steel angles and channels, and independent of the sheet metal covering.

THE LORD ELECTRIC COMPANY, New York city, has issued Bulletin D, of twenty-four pages, describing laminated soldered rail bonds. A portable electric rail grinder and the Leco duplex bonding torch are also described in this publication, as well as a form of portable hand-power grinding machine.

THE BRISTOL COMPANY, Waterbury, Conn., has issued Bulletin No. 104, of forty pages, styled a "preliminary bulletin" of Bristol's recording gauges for all commercial ranges of pressure and vacuum. The illustrations, diagrams, letterpress and general get-up of this bulletin are exceptionally good, and it should be kept on file for reference purposes.

THE HOYT ELECTRICAL INSTRUMENT WORKS, Penacook, N. H., on account of rapidly increasing business having found it necessary to secure more room for the New York office, moved on June 1 to 136 Liberty Street, where the company has greatly increased space and facilities, and is in a better position than ever to give all orders the best possible attention.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Pittsburg, Pa., has published a neat little booklet, entitled "The Mission of the Westinghouse Electric Toaster-Stove," which is an account of the construction and use of this handy little device, "told by itself," in narrative form. Everyone who uses electricity will find a multitude of profitable suggestions in this unique booklet.

THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J., has issued for free distribution an interesting and valuable twenty-four-page booklet, entitled "The Proper Care of Belts." While this is primarily a boost for the various belt dressings prepared by the above company, it contains so much practical information on the subject of belts and belt transmission that it is well worth a careful perusal.

THE WESTERN ELECTRIC COMPANY is distributing a paperweight in the form of a copper medallion nearly two-and-three-fourths inches in diameter and having an antique bronze finish. On each face is the well-known trade-mark of the company, with the names of the principal distributing cities marked on the map of the United States. Surrounding the design are the exhortations "Consult the Map" and "Write Our Nearest House."

THE LINCOLN MOTOR WORKS COMPANY, Cleveland, Ohio, announces that it has changed its name and that it will henceforth be known as "The Reliance Electric and Engineering Company." The manufacture of Lincoln variable-speed motors will be continued by the company, and complete lines of constant-speed motors are being added. The company proposes to specialize in modern shop practice, especially in the application of the electric motor drive to machinery.

THE C. W. HUNT COMPANY, New York city, has issued Catalogue No. 091 ("Engineer's Edition"), containing eighty-eight pages of printed matter and illustrations descriptive of coal and ore-handling machinery for power stations, gas companies, blast furnaces, coal yards, coaling stations, shipping docks, manufactories, boiler rooms, etc. Given away with this fine catalogue is a metric conversion table prepared by the company and printed on adhesive paper for convenient insertion in memorandum books, etc.

THE MINNEAPOLIS STEEL AND MACHINERY COMPANY, Minneapolis, Minn., has issued Catalogue G 105 describing stationary and portable gas and gasoline engines of from four to fifty horsepower, manufactured by the Ohio Motor Company. Besides these engines the Minneapolis company announces that it is carrying a very large stock of "Dodge" and "Twin City" power transmission appliances, such as hangers, pillow blocks, bracket boxes and post boxes, with either standard ring or capillary oiling bearings; flanged or compression couplings, set collars, "Dodge" split-iron pulleys, from four inches to forty-eight inches in diameter, which can be accurately and quickly placed on any standard-

sized shaft; also a full stock of "Dodge" friction clutch couplings, and pulleys either solid or split; turned or cold-rolled shafting. The company carries the largest stock in the Northwest and has unexcelled facilities for prompt shipments. Moreover, being manufacturers, special sizes or designs can be made to order. A specialty is made of conveying and elevating machinery, headgate hoists, etc. Catalogues covering this class of work may be had on application.

THE POWER EQUIPMENT COMPANY, 1405 Fisher Building, Chicago, is installing at Wheatley, Ark., a 300-kilowatt power plant to be used principally for operating wells for irrigation of rice fields of the Wheatley Rice Mill and Power Company. The machinery installed consists of two 150-kilowatt General Electric generators and Hamilton Corliss and Phœnix automatic engines with a battery of two Atlas and one Edgemoor boilers. S. D. Boynton has charge of the work on the job and B. K. Howard of the buying end in the Chicago office, 1405 Fisher Building.

THE PEIRCE SPECIALTY COMPANY, of Elkhart, Ind., has published a sixteen-page booklet, in which are demonstrated pictorially the general advantages and the simplicity of the manner of using Peirce all-steel brackets. In an effective series of pictures Mr. Peirce is shown making a hole in a brick wall with a Peirce hammer-drill, inserting the expansion-bolt and forcing its lead sleeve in place by using the reverse end of the hammer-drill. There are also shown various forms of the brackets and details of the expansion bolts and hammer-drill used.

THE CENTRAL ELECTRIC COMPANY, of Chicago, is distributing a new circular calling attention to the latest quotation on rubber-covered wire, single braid, double braid, solid, stranded and fixture. Prices are also given on the Banner brand weatherproof and slow-burning wire. There are also included the latest reduced prices on D & W fuses, cut-outs and contacts. Another circular points out the advantages of the G. E. bell-ringing transformer. The company has also for distribution an interesting "Hail Columbia" souvenir postcard; as may be surmised, it boosts the Columbia tungsten lamps, which this company handles.

RECORD OF ELECTRICAL PATENTS.

Issued (United States Patent Office) May 25, 1909.

922,456. AUTOMATIC SPRINKLER SYSTEM. James P. Casey, St. Louis, Mo. Filed February 9, 1907. An electric alarm is sounded when the pressure in the system pipes varies beyond a certain degree.

922,462. TELEGRAPHY. Thomas B. Dixon, New York, N. Y. Filed July 5, 1904. Renewed July 9, 1907. A polar double-current transmitter produces in the line at the beginning and again at the end of each of its signals a weaker current impulse, and a neutral double-current transmitter produces in the line at the beginning and again at the end of each of its signals a stronger current impulse.

922,464. PROTECTIVE DEVICE FOR ELECTRIC CIRCUITS. Arthur C. Eastwood, Cleveland, Ohio. Filed November 23, 1908. A magnetically closed switch has its contacts in the main circuit controlled by a controlling switch, and its winding shunted through the contact of the controlling switch when the magnetically controlled switch is open and the controlling switch is in any but the off-position.

922,466. INDICATOR. Harrison D. Flegel, Racine, Wis., assignor to Edward J. Schowalter, Racine, Wis. Filed July 24, 1903. The closing of an electric circuit causes a one-step movement of the pointer on the dial.

922,470. ANODE ELEMENT. Benjamin W. Gilchrist and George L. Rice, Woodhaven, N. Y. Filed June 9, 1908. The anode is provided with ears with which the suspending devices are connected, and is contained in a box one side of which is composed of openwork not extending to the top.

922,477. ELECTRIC LINE INSULATOR. Robert Henry, Pueblo, Colo. Filed October 5, 1908. Has an interior screw-threaded locking cap fitted on interior insulation.

922,490. ELECTROLIER BRACKET. Isaac Levinson, New York, N. Y. Filed July 15, 1908. An electric-light fixture has sockets arranged about a center so as to constitute various groups of different numbers, with the sockets equidistant in each group.

922,521. SHORT-CIRCUITING DEVICE FOR ELECTRIC MOTORS. Charles A. Schnur, St. Louis County, Mo., assignor to Wagner Electric and Manufacturing Company. Filed May 9, 1908. Short-circuiting laminæ connected by a flexible metallic ribbon are carried by a reciprocating member for electrically connecting a number of insulated contacts.

922,531. ELECTRIC AIR-HEATING AND DISCHARGING DEVICE. Louis A. Siebert, Columbus, Ohio. Filed March 28, 1908. Describes a hand device containing electric coils and an inlet and an outlet air valve.

922,540. SYSTEM OF MOTOR CONTROL. Harry F. Stratton, Cleveland, Ohio, assignor to The Electric Controller and Manufacturing Company. Filed October 1, 1908. The extent of an air gap in the magnetic circuit of one of two or more electromagnetically operated switches is adjusted between limits by another of the switches.

922,550. CLOCK-WINDING MECHANISM. Ernest E. Yaxley, Chicago, Ill. Filed April 2, 1908. A power device operating on and through a pawl to turn the toothed wheel of a motor mechanism has its power replenished by an electromagnet which also causes the pawl to have fresh tooth engagement.

922,554. HOISTING APPARATUS. Heinrich Aumund, Cologne, Germany, assignor to C. W. Hunt Company. Filed May 13, 1904. Electromagnetic devices control the operations of the hoisting drums and are themselves governed by contact devices actuated by a revolving indicator.

922,556. INSULATING JOINT. Asa F. Batchelder, Schenectady, N. Y., assignor to General Electric Company. Filed September 28, 1908. An insulating pipe joint comprises two heads, an interposed tube, means for clamping the parts together, and means for insulating the tube from the heads.

922,623. ATTACHING DEVICE FOR ELECTRIC FIXTURES. Louis A. Parrish, Great Barrington, Mass. Filed February 1, 1909. Has end portions adapted to engage, when projected, portions of an outlet box.

922,654. SAFETY ELECTRICAL CIRCUIT-BREAKER. William F. Wocher, Robert L. Lemon and Louis H. Mortsolf, Indianapolis, Ind. Filed February 19, 1908. Includes two separate electrical conducting elements, a conducting connector normally connecting the two elements and movable from one of the elements, a retractable locking device automatically acting to engage and hold the connector when disconnected from the element, and means for retracting the device from engagement with the connector.

922,662. ELEVATED TRANSPORTATION SYSTEM. Arthur E. Brock, Detroit, Mich., assignor of one-half to Henry P. Foglesang, Springport, Mich. Filed September 17, 1908. A motor car operated by an explosion motor is suspended from a cable track and electrically controlled from the several stations.

922,673. IGNITION SYSTEM FOR INTERNAL-COMBUSTION ENGINES. Mark B. Crist, Pittsburg, Pa., assignor to the Westinghouse Machine Company. Filed February 15, 1906. An electric ignition control apparatus has means for retarding or advancing the ignition in accordance with the speed of the engine.

922,726. BATTERY ELECTRODE. Charles B. Schoenmehl, Waterbury, Conn. Filed June 10, 1908. A negative electrode for batteries comprises a series of compressed copper oxide sections arranged adjacent to but spaced one from the other, a perforated cylinder around which they are supported one above the other, and means for engaging and supporting the cylinder.

922,727. BATTERY-ELECTRODE SUPPORT. Charles B. Schoenmehl, Waterbury, Conn. Filed June 10, 1908. A sheet-metal frame engages the four edges of a negative plate, the edges of the frame being turned over on the sides of the plate to hold the same in place, and L-shaped rods are secured to the upper part of the frame for supporting it from a cover.

922,728. BATTERY-ELECTRODE SUPPORT. Charles B. Schoenmehl and William G. C. Krause, Waterbury, Conn.; said Krause assignor to said Schoenmehl. Filed June 10, 1908. Has a U-shaped wire frame with negative plate electrodes arranged within it, and sheet-metal intermediate cross-strips against the top and bottom edges of the plate, electrodes to hold them in position, with means for clamping the electrodes and strips together.

922,729. BATTERY-ELECTRODE SUPPORT. Charles B. Schoenmehl and William G. C. Krause, Waterbury, Conn.; said

Krause assignor to said Schoenmehl. Filed June 10, 1908. Has an inverted U-shaped wire frame with nuts threaded on its lower free end, sheet-metal channel strips secured to this, and means for attaching the frame to a battery cover.

922,730. BATTERY-ELECTRODE SUPPORT. Charles B. Schoenmehl, Waterbury, Conn. Filed June 10, 1908. Renewed April 6, 1909. There are two rectangular wire frames to engage the opposite faces of an electrode, each frame having an extension with means for attachment to a cover, and means for securing the two frames against the electrode.

922,731. BATTERY-ELEMENT SUPPORT. Charles B. Schoenmehl, Waterbury, Conn. Filed November 30, 1908. The frame has an upper wire cross-piece with its intermediate portion bent up and around to form an integral eye for the attachment of a binding post.

922,736. ELECTRIC COAL PUNCHER OR MINING MACHINE. John H. Thompson, Charleston, W. Va., assignor to Johnson Electric Machine Company. Filed July 31, 1907. A reciprocatory tool-holder is driven by an electric motor, and automatic means are provided whereby the forward stroke of the tool-holder is reversed when the tool or pick strikes a hard or impenetrable object.

922,742. INSULATING RAIL JOINT. Benjamin Wolhaupter, New York, N. Y., assignor to The Rail Joint Company. Filed September 20, 1906. Describes a form of composite chair insulated from the rail joint it supports.

922,746. ELECTRIC SWITCH. Charles R. Beebe, New Haven, Conn. Filed January 11, 1909. Describes the details of a two-point electric switch.

922,752. ELECTRIC TRAIN OR VEHICLE. John L. Creveling, New York, N. Y. Filed March 26, 1903. A prime mover (or movers) operates dynamos which in turn operate motors for driving the train, the dynamos being arranged in series to drive the motors in multiple, or vice versa.

922,801. ELECTRIC CUT-OUT. Thomas E. Murray, New York, N. Y. Filed November 9, 1908. A fuse-case holder has an upper member, a depending member independently and detachably secured to the upper member and having a transverse opening, and a removable fuse case seated in and extending through the opening.

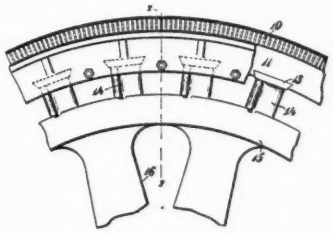
922,802. POWER-TRANSMITTING DEVICE. Frank R. McBerty, New Rochelle, N. Y., assignor to Western Electric Company. Filed February 27, 1908. Describes a form of electromagnetic clutch.

922,823. MULTIPLE-VOLTAGE CONTROLLER. Emmett W. Stull, Norwood, Ohio, assignor to Allis-Chalmers Company and The Bullock Electric Manufacturing Company. Filed October 31, 1906. Has fixed and movable contacts constructed and arranged to change the connections of a translating device from any pair of multiple-voltage mains to another without interrupting the circuit.

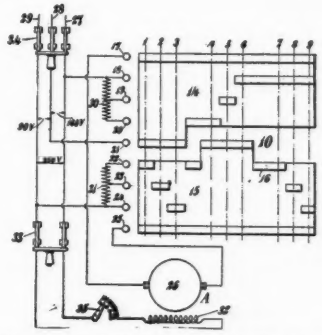
922,825. OIL SWITCH. Hermon L. Van Valkenburg, Norwood, Ohio, assignor to The Bullock Electric Manufacturing Company. Filed August 25, 1905. Describes a form of four-break single-pole switch.

922,836. ELECTRIC ADVERTISING APPARATUS. Giuseppe Bandieri, Cincinnati, Ohio. Filed April 30, 1908. An electric motor intermittently operates a roller to move a film or ribbon, of which the part that is in proximity to an opening is illuminated by an electric lamp or lamps.

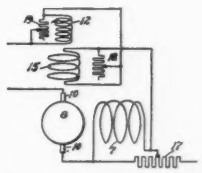
922,839. DYNAMO-ELECTRIC MACHINE. Bernard A. Behrend, Norwood, Ohio, assignor to Allis-Chalmers Company and The Bullock Electric Manufacturing Company. Filed June 5, 1905. Comprises an armature winding, a main field winding, a winding for compensating armature reaction, a concentrated commutation winding (the compensating and commutation windings being in separate groups), and means for adjusting the current strength in the commutation winding independently of the current strength in the other windings.



922,794.—ROTOR CONSTRUCTION.



922,823.—MULTIPLE-VOLTAGE CONTROLLER.



922,839.—DYNAMO-ELECTRIC MACHINE.

922,760. POLE-PIECE-FASTENING DEVICE. John D. Firmin, Pleasant Ridge, Ohio, assignor to The Bullock Electric Manufacturing Company. Filed September 14, 1905. Describes a method of securing a laminated pole-piece for a dynamo or motor.

922,764. IGNITER-TIMING DEVICE. James G. Heaslet, Detroit, Mich., assignor to the Garford Company. Filed July 17, 1907. Describes a timer for the operation of a number of electric sparking devices as for an internal-combustion engine.

922,780. CABLE RELAY. Isidor Kitsee, Philadelphia, Pa. Filed August 8, 1907. A cable relay unresponsive to shifting zero effect comprises two movable coils biased toward normal position, and a relay contact carried by each coil, the movement of the coils being unrestricted and adapted to move the relay contacts in opposite directions.

922,781. PRINTING TELEGRAPH. Isidor Kitsee, Philadelphia, Pa. Filed August 25, 1908. Includes a polarized line relay, a master step-by-step mechanism controlled by the relay, and an associate step-by-step mechanism controlled by the master.

922,794. ROTOR CONSTRUCTION. Emil Mattman, Norwood, Ohio, assignor to Allis-Chalmers Company and The Bullock Electric Manufacturing Company. Filed May 31, 1907. The rotor comprises a wheel provided with ribs around its periphery and arranged at an angle to the axis of the wheel, also an annular core mounted on the ribs, and windings on the core.

922,800. PROCESS IN MAGNETIC SEPARATION. Walter B. Moore, Seattle, Wash. Filed August 31, 1906. The process consists in feeding the mass of materials into a magnetic field to extract the magnetic particles from the remainder, conveying the extracted magnetic particles, magnetically impelling them across a passageway, directing a fluid on them and subjecting them to a rapid reversal of magnetic polarity to cause them to turn end over end.

922,849. INDICATOR FOR AUTOMATIC ELEVATOR SYSTEMS. Albert H. Buckelew, Newark, N. J. Filed March 29, 1907. An automatically controlled elevator system has a signal for automatically indicating at a floor when a well door is open, and a light controlled by the starting switch for illuminating this signal.

922,917. ELECTRIC TERMINAL. Gilbert C. Landis, York, Pa., assignor to American Phosphorus Company. Filed April 3, 1907. Describes a form of water-cooled terminal for an electric furnace.

922,924. DYNAMO-ELECTRIC MACHINE. Charles E. Lord, Norwood, Ohio, assignor to Allis-Chalmers Company. Filed May 3, 1906. The stator consists of laminæ of magnetic material, some of which have a less outer diameter than others, whereby circumferential ventilating passageways closed at the inner periphery of the core are provided.

922,946. DYNAMO-ELECTRIC MACHINE. William D. Pomeroy, Norwood, Ohio, assignor to Allis-Chalmers Company and The Bullock Electric Manufacturing Company. Filed July 27, 1906. The rotor comprises a core, coils carried thereby and having end turns projecting beyond the core, a rigid ring surrounding the end turns, an endless expansible ring within the end turns and in engagement with the latter, and means for expanding this ring comprising a movable expanding ring in one integral piece and engaging the inclined surface of the expansible ring.

922,951. THIRD-RAIL INSULATOR. Leonard M. Randolph, Newark, N. J., assignor to Essex Company. Filed May 2, 1907. Consists of a short section of channel iron for the

base, a short section of an I-beam for a rail support, and insulating material between them to which they are loosely connected.

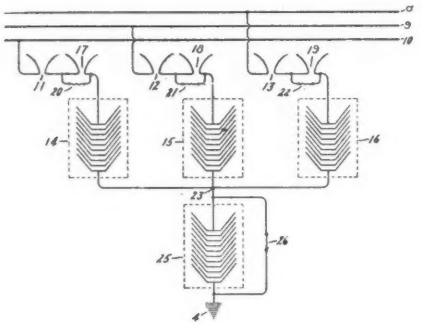
922,977. ROSETTE. Edgar Tregoning, Attleboro, Mass. Filed November 6, 1908. Has a base provided with an inwardly extending box, a removable cap provided with a central opening, two wire terminals, and two strain-receiving members arranged to overlie the boss formed on the base.

922,987. ELECTRIC IGNITER FOR EXPLOSIVE ENGINES. Emil Westman, Minneapolis, Minn. Filed October 5, 1907. A metallic plug has a fixed and a movable electrode, the latter co-operating with the armature of an electromagnet.

923,005. PROCESS OF TREATING NICKEL ORES. Anson G. Betts, Troy, N. Y. Filed February 23, 1909. The process consists in smelting the nickel ores to an alloy with another metal of the iron group, and electrolytically refining the alloy, using an electrolyte containing a soluble salt of each of such two metals, and producing a refined alloy containing the two metals.

923,018. ELECTRIC FURNACE. Frederic M. Chaplet, Laval, and Alexandre Remond, Paris, France. Filed March 19, 1907. Consists of two distinct compartments and a communicating passage which contains the conducting material, the open compartment receiving a carbon or metal electrode plunging into the conducting mass, and the closed compartment or laboratory receiving a carbon electrode forming an arc with the molten metallic surface. The tap is formed in the wall of the furnace above the passage connecting the two compartments.

923,020. DEVICE FOR AUTOMATICALLY STOPPING VEHICLES. Sidney H. Cluxton, Washington, D. C. Filed January 5, 1907. An air brake is actuated by the movement of shoes attracted by electromagnets secured to the track rails.



923,024.—LIGHTNING ARRESTER.

923,024. LIGHTNING ARRESTER. Elmer E. F. Creighton, Schenectady, N. Y., assignor, by mesne assignments, to General Electric Company. Filed July 9, 1906. A condenser associated with a spark gap is connected between each of the line conductors of a transmission system and the ground, and means are provided for introducing each spark gap in series with its condenser when one of the line conductors becomes grounded.

923,033. TELEGRAPH TRANSMITTER. Thomas J. Dunn, Jersey City, N. J. Filed December 31, 1908. Has a vertically reciprocatory plunger adjacent to the free end of the vibrator, and a cam member carried by the plunger adapted to engage the vibrator when the plunger is in its raised position.

923,035. TELEPHONE SYSTEM. Alfred H. Dyson, Chicago, Ill., assignor to American Electric Telephone Company. Filed January 20, 1902. In combination with a single cord and plug for the trunking operator, are two supervisory lamps associated with this single cord, suitable local circuits and a source of current supply for operating the supervisory lamps, and a differential relay for controlling the flow of current through one lamp, and a number of relays for controlling the flow of current through the other lamp.

923,071. ELECTRICAL CONNECTOR. Granville E. Palmer, Boston, Mass., assignor of one-fourth to Charles B. Price and one-fourth to F. S. Price, Boston, Mass. Filed November 21, 1906. Is a form of sheet-metal clip for embracing a pipe or cable and provided also with a wire-receiving socket.

923,114. FIRE-ALARM TELEGRAPH APPARATUS. Frederick W. Cole, Newton, Mass., assignor to the Gamewell Fire-Alarm Telegraph Company. Filed October 24, 1908. Describes a form of local fire-alarm-box apparatus.

923,115. FRANGIBLE PROTECTING DEVICE. Frederick W. Cole, Newton, Mass., assignor to the Gamewell Fire-Alarm Telegraph Company. Filed October 27, 1908. Consists of a pivoted frame having a front opening closed by a glass plate and having a shield behind this to provide a pocket to receive the broken pieces of glass.

923,124. MERCURY OR OTHER VAPOR ELECTRIC LAMP. Henry A. Kent, Bounds Green, and Harold G. Lacell, Finchley, England, assignors to Silica Syndicate, Limited, London, England. Filed October 3, 1908. Comprises a stationary vaporizing tube adapted to contain the material vaporized, and a container at atmospheric pressure located above this tube and communicating therewith by a constricted passage through which the material can be only slowly forced by the vapor generated during the operation of the lamp, whereby the arc is steadied.

923,127. ELECTRIC ARC LAMP. Ladislav O. Kozar, Wilkes-Barre, Pa., assignor of one-half to Joseph Murgas, Wilkes-Barre, Pa. Filed March 17, 1909. The movement apart of the angularly disposed electrodes is retarded by means of a dashpot, an electromagnet causes the electrodes to come together to strike the arc, and the dashpot is put under spring tension tending to prevent separation of the electrodes when the electromagnet is de-energized.

923,128. PROCESS OF ELECTRIC WELDING. Maurice Lachman, New York, N. Y. Original application filed October 17, 1906. Renewed November 29, 1907. Again renewed August 22, 1908. Divided and this application filed March 31, 1908. Describes a method of electrically welding the end or butt of one piece of metal to the flat surface of another.

923,129. ELECTRIC SWITCH. Edmund O. Schweitzer and Alfred Herz, Chicago, Ill. Filed July 19, 1906. Comprises a rotary member carrying a double-chambered inverted holder containing mercury or some other mobile conductor, contacts on the holder whereby the connection will be closed through the switch upon the passage of the mobile conductor from one chamber to another, connections co-operating with these contacts and a conductor extending across the rotary member to short-circuit and permanently close the circuit when the mobile conductor is in either chamber, means for rotating the rotary member and contacts co-operating with the conductor whereby the circuit can be closed a predetermined length of time by the mobile conductor or can be permanently closed through the conductor on the rotary member.

PATENTS THAT HAVE EXPIRED.

Following is a list of electrical patents (issued by the United States Patent Office) that expired June 1, 1909:

475,759. ELECTRIC METER. O. Ericsson, Sioux Falls, S. D.

475,783. CONTACT POST FOR ELECTRIC BELLS. F. W. Manger and O. H. Huebel, Brooklyn, N. Y.

475,797. SECONDARY-BATTERY ELECTRODE AND PROCESS OF MAKING THE SAME. A. Reckenzaun, London, England.

475,809. ELECTRIC SELF-WINDING CLOCK. F. M. Schmidt, Brooklyn, N. Y.

475,877. SYSTEM OF ELECTRICAL DISTRIBUTION. C. O. Mailloux, New York, N. Y.

475,898. RHEOSTAT. F. W. A. Schneider, Toronto, Canada.

475,920. ELECTRIC CONDUCTOR. C. W. Bassett, Newton, Mass.

475,925. AUTOMATIC FIRE-ALARM SYSTEM. C. Burgher, Newton, Mass.

475,938. TELEGRAPHY. T. Gothorpe, Rye, N. Y.

475,970. ELECTRIC RAILWAY MOTOR. J. F. Shawhan, Detroit, Mich.

476,026. TELEPHONE. S. F. Sherman, New York, N. Y.

476,054. TELEPHONOGRAPH. J. P. Magenis, North Adams, Mass.

476,080. ELECTRIC TERMINAL. Detroit, Mich.

476,128. CONDUIT FOR ELECTRIC RAILWAYS. W. P. Carr and C. F. Ferrin, Minneapolis, Minn.

476,151. DYNAMO-ELECTRIC MACHINE. W. Koedding, St. Louis, Mo.

476,156. DEVICE FOR TESTING ARC-LIGHT CIRCUITS. A. H. Manwaren, Philadelphia, Pa.

476,183. INCANDESCENT LAMP. J. Ball, Holyoke, Mass.

476,200. TELEPHONE. E. M. Harrison, Fort Smith, Ark.

476,225. ELECTRICAL RECIPROCATING TOOL. W. P. Carstarphen, Jr., Denver, Colo.